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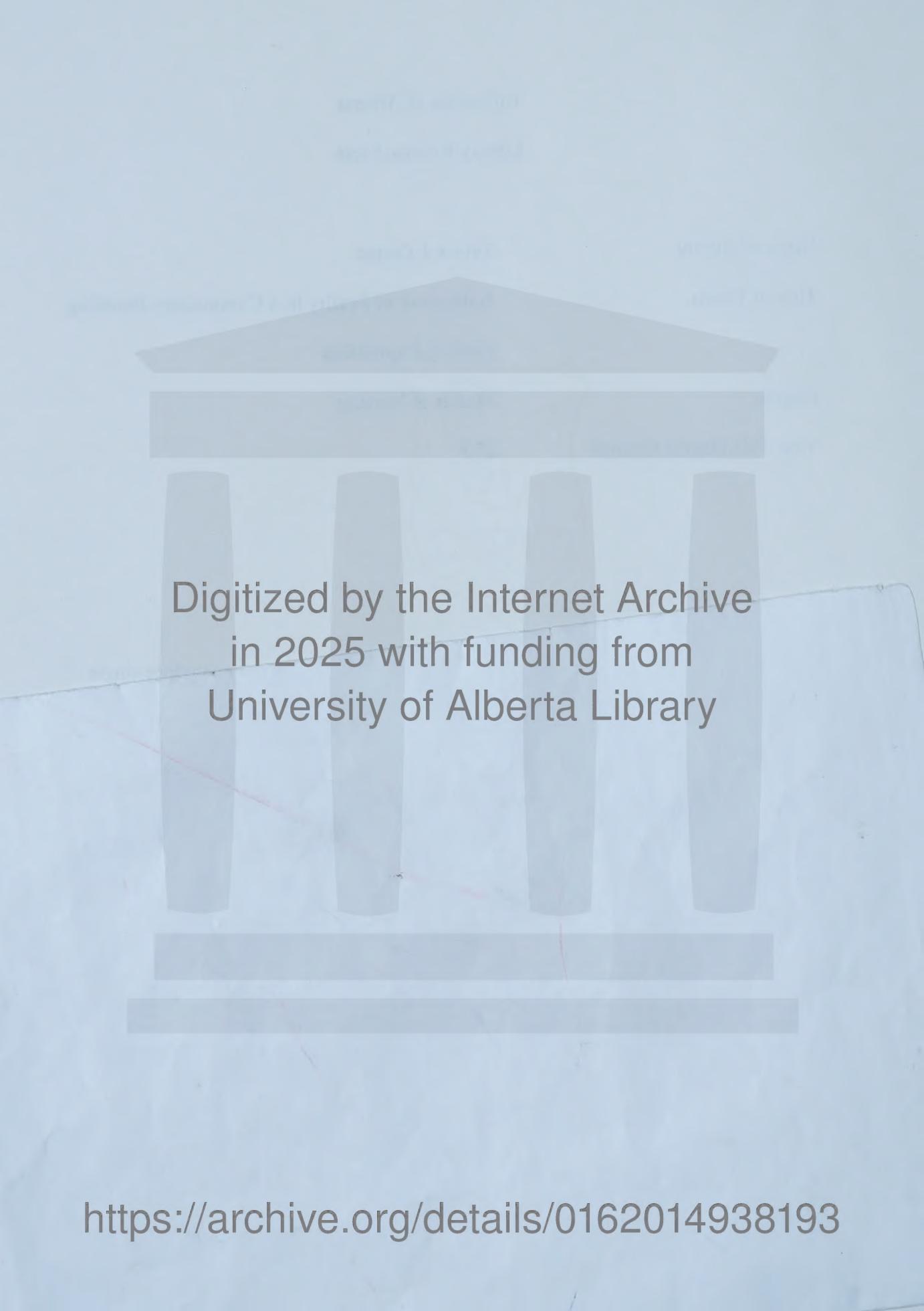
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Indicators of Frailty in a Community-Dwelling Seniors Population

by

Teresa J. Genge 

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment
of the requirements for the degree of Master of Nursing

Faculty of Nursing

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Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Indicators of Frailty in a Community-Dwelling Seniors Population* submitted by *Teresa Jean Genge* in partial fulfillment of the requirements for the degree of *Master of Nursing*.

This study is dedicated to all seniors who shared their story with me.

Abstract

The purpose of this study was to identify key indicators of frailty by addressing the three domains of functional abilities measured with cognitive, ADL, and IADL scales; physiological stresses including age, and number of chronic diseases; and social supports, including number of informal and formal caregivers. The study population comprised of seniors accessing an outpatient clinic.

Principal components analysis was used to reduce the data to three prevalent factors: functional abilities, cognitive abilities, and chronological age. Direct discriminant analysis evaluated the predictability of the factors in classifying subjects according to three discharge dispositions: individuals able to return home without any services (mild frailty), those returning home with additional services (moderate frailty), and those needing hospitalization (severe frailty). These discriminant functions had prediction rates of 75.6% for those returning home with increased services, 56.9% for those returning home without services, and 12.2 % for those needing hospitalization. The results indicate that functional abilities were the best means of determining those seniors who were considered moderately frail and were able to return home with support.

Acknowledgements

When I first considered starting my thesis I was driven by the thrill of a challenging proposition. However, the anticipation of continuing my education to the next level filled me with self doubt. It was the encouragement and belief from friends and family that allowed me to take on this endeavor. I would like to thank them for pushing me to take the first step.

As the learning progressed the journey became difficult, with multiple bumps and detours, the enthusiasm that fueled my motivation dwindled. Once again it was the support of those closest to me who inspired me to continue. With their support I was able to once again take on the project with a new intensity.

Towards the end of my studies the allure of the undertaking had diminished and I was filled with fatigue and apathy. I again relied on the encouragement of those closest to me for the strength to proceed. I would personally like to thank my superbly supportive family, fantastic co-workers, and loyal friends for the support and encouragement they have lovingly provided throughout the years to carry this endeavor through to completion.

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CHAPTER ONE

INTRODUCTION

The aging population has brought on a new awareness in health care delivery for the geriatric patient. In the next few years this cohort will expand, and the majority of health care professionals involved with adult health will serve this population. The fastest growing section of the elderly will continue to be the old-old; that is, individuals 85 years and older (Stats Canada, 1999). An extended life span will have a detrimental effect on health delivery to all Albertans because a large portion of the provincial government budget is channeled towards the maintenance of health. Advanced age brings some functional decline in the motor, sensory, and cognitive domains, as well as an increase in chronic diseases (Alberta Health and Wellness, 1999). Care of the elderly patient involves managing the symptoms associated with chronic illness and recognizing acute changes promptly so that early intervention is possible. Determining methods of tracking seniors who are at risk of experiencing a decline in health will prompt health care professionals to direct services efficiently and reverse any loss of independence, therefore improving a person's quality of life.

Population Growth

In the province of Alberta 10% of the population is over the age of 65, with the fastest growing age group between 55 and 64 and greater than 85 years of age. This aging trend is expected to increase at the beginning of 2001 and peak in 2031 as the baby boomers age. In the coming years the elderly population is expected to increase to 1.6 million nationwide. In 1996 the estimated life expectancy of an average male living in Alberta was 76 years, with a predicted 5.2 years to be spent in poor health; and the

average age of a female was 81.3 years, with 6.2 years to be spent in poor health. With the increase in life expectancy there is also a predicted increase in disability of 3.8% in women and 3.3% in men over the age of 85 (Statistics Canada, 1999). In the future the focus of health care will largely be on management of chronic illness to deal with the shifting needs of the main consumers of the health care system (Wagner, 1999).

Health Care Delivery

Health care reform in Alberta has brought a change in the delivery of health services from institutional and hospital centered to a stronger community focus. This philosophy of community care has heightened awareness of acute care geriatrics, with particular reference to the need for timely assessment and intervention in order to maintain the independence of seniors. Assessment of seniors is best accomplished by a team of disciplines that have (a) a focus on care of the frail elderly (Evans, Yurkow, & Siegler, 1995), (b) knowledge of the atypical presentation of disease in this age group (Ciccone, Allegra, Cochrane, Cody, & Roche, 1998; Jarrett, Rockwood, Carver, Stolee, & Cosway, 1995), (c) the skills and tools to assess functional loss (Saunders & Morley, 1993), and (d) the ability to coordinate care among many services and the commitment to ensure that community follow up is carried out (Evans et al., 1995; Freeman & Zack, 1996). Boult, Boult, and Pacala (1998) stated that geriatric teams are more effective if they provide some management of the person's care. However, fiscal restraints do not always allow for this to occur. In such cases it is important to develop strong partnerships with community services so that the recommended plan is carried out and evaluated, and any changes are reported back to the geriatric team for ongoing management.

Appropriateness of referrals to a geriatric team is difficult to measure. Often the community worker sends the patient to the geriatric service to sort out the person's needs, and he/she feels that identifying the problem is part of the assessment. Those patients presenting with a geriatric symptom such as incontinence, cognitive decline, mobility concerns, or polypharmacy (Freeman & Zack, 1996; Gold & Bergman, 1997; Stuck et al., 1995), or those who are considered to be frail (Rockwood, Fox, Stolee, Robertson, & Beattie, 1994), are recorded as receiving the maximum benefit from a geriatric team. Although geriatric specialists can identify geriatric symptoms, the community worker is not as skilled (Man-Son-Hing, Power, Byszewski & Dalziel, 1997), which leads to lack of clarity as to who would benefit from a comprehensive geriatric assessment.

Clinicians use the term *frail* to describe the most complex, vulnerable senior who would most benefit from a geriatric assessment. However, there is not a great deal of consensus on the meaning of the concept of frail in the literature. Because there are no specific conceptual descriptors of the term, subjective view based on the user's own definition prevails (Geasley, 1997; Rockwood et al., 1994). Even without specific descriptors, the term has increasingly been used in the literature (Rockwood et al., 1994) and is successful, among clinicians, to describe a population in need. Some clinicians use the term to describe a temporary state (Brocklehurst, 1985; Buchner & Wagner, 1992; Rockwood et al., 1994), or a nonstatic condition in which a person moves along a continuum of becoming more or less frail (Brown, Renwick, Raphael, 1995). Others view frailty as a permanent condition (Brown, 1997; Geasley, 1997; Palmore, Nowlin, & Wang, 1982). Increasing age is often associated with frailty (Hogan, Erika, & Fung, 1999), whereas functional abilities are thought by some to be a better measurement of

frailty (Geasley, 1997; Palmore et al., 1982; Pressley & Patrick, 1999). Worrall, Chaulk, and Briffett (1996) found that cognitive impairment was a strong predictor of the need for supportive community services and felt that this is a marker of frailty. An operational definition of frailty that is dynamic allows the concept of frailty to be interpreted as temporary and reversible. A multilevel definition of frailty covering the three domains of pathology or disease influence, functional limitations, and disability, or a description of a person's interaction with the environment is needed to cover all aspects of frailty (Campbell & Buchner, 1997). Campbell and Buchner viewed frailty as a preventable or reversible state and defined it as a

condition or syndrome which results from a multi-system reduction in reserve capacity to the extent that a number of physiological systems are close to, or past, the threshold of symptomatic clinical failure. As a consequence, the frail person is at risk of disability and death from minor external stresses. (p. 315)

Many tools have been identified for successfully screening community seniors for disabilities and for needing community services. Barberger-Gateau et al. (1992) were able to screen for cognitive disabilities in the community elderly person using instruments that measure instrumental activities of daily living (IADL). Geasley (1997) found that the IADL assessment scales are tools that all professionals can use to objectively classify who is at risk for frailty. Worrall, Briffett, and Moulton (1994) used the Mini Mental State Examination to determine which seniors in the community were in need of home care services. All of these studies identified variables of importance in classifying frailty with tools already being used in a geriatric assessment. Adopting tools to measure frailty that have been standardized to measure concepts such as instrumental activities of daily living, basic activities of daily living, or cognition provides a fragmented description of the term. The use of multiple tools to measure frailty is not

necessarily practical in clinical areas that do not specialize in geriatric care because these tools are time consuming and repetitive to administer, and require specific training to utilize. Other studies have attempted to identify specific indicators that will specifically measure the concept of frailty (Brody, Johnson, & Reid, 1997; McCusker et al., 1999; Paw, Dekker, Feskens, Schouten, & Kromhout, 1999; Rockwood et al., 1999; Speechley & Tinetti, 1991; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998). Over the past few years, progress has been made towards the measurement of frailty; however, criteria used for the selection of indicators of frail elderly remain unstandardized (Paw et al., 1999), making it difficult to measure the concept accurately.

A more succinct scale that could directly measure the variables of frailty would allow for prompt identification of functional losses, earlier interventions, and measurement of change with each intervention. A specific measurement of frailty could be derived from a process involving modifying the multiple assessment scales in widespread use in the clinical area. The items in each of these scales need to be studied to identify key components of each scale that represent dimensions of frailty.

Purpose of the Study

Review of the literature relative to definitions of frailty suggests the need for ways of measuring frailty. Standardized tools presently in use measure components of frailty, but the concept itself remains elusive. Although clinicians can achieve consensus on the meaning of frail, in the practical situation a definitive way of classifying and documenting frailty has not, as yet, been identified. In this study frailty was viewed as a dynamic state in which a person experiences dependence in the ability to manage activities of daily living due to intrinsic or extrinsic stresses. The aim of this study was to

identify the primary indicators that can be used to measure the concept of frailty, including the three domains of functional abilities, physiological stresses, and social support. The principal objective of the study was to determine which of the multiple variables identified in the literature are the key indicators that can be used to identify frailty in an elderly seniors population living in the community. If it is possible to identify key variables, they could then be studied more definitively on a prospective basis to determine how well they predict frailty.

Significance of the Study

Elderly populations are typically confronted with the need to cope with a number of chronic diseases as well as the impact of the aging process. Controlling disease risk involves differentiating between the acute complications associated with the disease and the symptoms of the disease itself. The ability to measure frailty may provide a significant gauge to predict acute changes and allow for prompt interventions (Pressley & Patrick, 1999). Utilization of a scale that measures frailty may potentially provide objective indicators for assessing the need for increasing community services (Geasley, 1997). Hogan et al. (1999) stressed the need to focus on preserving function when planning for the care of the over-85 age group rather than focusing entirely on disease prevention. In its 1999 provincial government report, the Alberta Policy Advisory Committee made recommendations for changes in the delivery of health care to seniors. One of the recommendations of the committee was that health professionals in the community and in acute care hospitals have processes in place to identify those seniors at risk. A means of measuring frailty would be useful in defining the population that should be targeted and would afford a means of tracking the outcomes of interventions that were

provided. A common understanding of who is frail and how to address the needs of this population would be of considerable value in maintaining the independence of seniors. At the present time there are multiple variables that measure frailty. Thus the tools are long and cumbersome to use. The length of time that it takes to complete these tools makes it difficult to recruit health professionals to utilize these tools. Key indicators of frailty would eliminate redundant testing and allow for concise measurement of the concept.

CHAPTER TWO

LITERATURE REVIEW

Each of us tends to think we see things as they are, that we are objective. But this is not the case. We see the world, not as it is but as we are. (Anonymous)

Personal attitudes and beliefs about aging influence how professionals deliver health care services to seniors. Unfortunately, the more common outlook on aging is analogous with thoughts of pain and immobility. If a person feels that all elderly suffer with memory loss and immobility, then these symptoms go undetected because they are seen as the norm. Seniors also often accept painful symptoms as normal and refrain from reporting them. This makes it difficult for clinicians to assess and treat their problem. The elderly present atypically when ill and have multiple complex problems that are closely intertwined and very time consuming to separate. Another challenge associated with aging is that there is a lack of physiological reserve that lowers a person's ability to cope with multiple stresses. Therefore, with advanced age there is an increased risk of hospitalization and institutionalization. Timely intervention from professionals who are knowledgeable on the needs of this age group could prevent rising health care costs and preserve a person's quality of life. The difficulty for clinicians is identifying who is at risk, what they are at risk of, and how to establish a process that will reverse the factors placing the person at risk. The Comprehensive Geriatric Assessment has been shown to enhance the care of those seniors who are at risk or frail. Geriatric services rely on other health professionals across the health care system to refer seniors for a geriatric assessment, yet few professionals not working in geriatrics have a clear understanding of who are representative of this group. Indicators of frailty have been identified throughout

the literature with limited consensus as to the key indicators that will accurately measure frailty. There is a need for a tool that will accurately measure frailty so that those representatives working in health care will be able to identify this vulnerable group. The literature was reviewed to establish an operational definition of frailty and to determine which indicators can be utilized in the clinical setting to measure the term accurately.

Attitudes Toward Aging

The normal aging process is often interpreted to include increased pain, decreased mobility, and memory loss (Herrick, Peracy, & Ross, 1997; Keister & Blixen, 1998). This outlook on aging results in an underreporting of symptoms because they are not seen as reversible. Seniors often feel that they must learn to live with these discomforts (Besdine, 1995; Rockwood et al., 1994). There is also the dread that further investigation will lead to a loss of independence, normalcy, and personhood (Gwyther, 1997). Rockwood et al. classified negative attitudes towards aging as a marker for frailty. They wrote that acceptance of immobility and dysfunction as normal makes it difficult to motivate a person to make lifestyle adjustments necessary to preserve function. Without the motivation to improve, the person becomes increasingly dysfunctional and dependent for his/her care, which further fulfills the belief that increased age is associated with increased dependence.

Attitudes regarding the care of the elderly are often met with frustration among clinicians (Besdine, 1995). Healthcare workers rarely see the healthy, active, productive elderly who are independent and disease free; instead they are challenged with small proportions of the population who are in need of medical attention. Exposure solely to the dependent group reinforces the opinion that the aging process is one riddled with disease.

These social attitudes become incorporated into belief systems and influence behavior and care (Herrick et al., 1997; Keister & Blixen, 1998). In order to meet the health care needs of the senior population, health care professionals must provide a holistic approach—including physical, psychological, social, and spiritual aspects—to care delivery rather than focusing on disease symptoms alone. Besdine stressed a need for all health care professionals to have a strong understanding of normal changes in aging rather than only those changes related to a disease process. Over the past few years the direct delivery of health care has become the responsibility of the less educated provider, such as personal care attendants, with the professional health care worker taking on a supervisory role. The professionals must rely on the assessment from the personal care attendant to alert them to any changes in the individual's health status. The need for a clearer understanding of normal aging will become more crucial as the frontline service providers in health care become less educated in theory-based practice and more focused on task delivery. Simplified guidelines or protocols must clearly define when and what needs to be reported by trained workers to health care professionals planning the care of the person.

Assessment of Seniors

The majority of health care expenditures are absorbed by the cost of hospitalization of the chronically ill elderly patient (Boult et al, 1993). In the province of Alberta “forty five percent of patient days in acute care hospital are used by people over the age of 65” (Alberta Health and Wellness Report, 1999, p. 26). This small portion of the population might enjoy better health and incur fewer hospital visits if they are identified early and treated preventively. Health professionals are challenged with the

management of fluctuations in the chronic illness as well as the need to recognize acute changes that require immediate intervention (Rosswurm & Lanham, 1998). The Policy Advisory Committee for the Government of Alberta made recommendations for the improvement of acute care service delivery to better meet the needs of an aging population. The committee stressed a necessity for integrating the services of acute hospital, ambulatory, and community care to provide a more comprehensive approach to the care of the elderly.

Assessment of the elderly person can be challenging and very time consuming (Boult et al., 1993; Fretwell, 1990; Jarrett et al., 1995; Rockwell et al., 1994). The presence of cognitive impairment and sensory losses complicates seniors' ability to provide an accurate description of their problem. Seniors often have difficulty describing symptoms, or fail to report them, omitting important aspects of the disease history. These omissions can lead the clinician to make an inaccurate diagnosis, inappropriately prescribe medications, and prevent linkage with appropriate community resources (Fretwell, 1990; Wagner, 1999).

The standard assessment and evaluation methods used by health professionals in various settings are not sensitive enough to detect the atypical presentation of disease in this age group (Jarrett et al., 1995; Lewis, Miller, Morley, Nork, & Lasater 1995; Miller, Lewis, Nork, & Morley, 1996; Naughton, Moran, Kadah, Heman-Ackah, & Longano, 1995; Rockwell et al. 1994). The Alberta report from the policy advisory committee (1999) identified that acute care and medical services are organized to deal with specific medical diagnoses rather than complex chronic problems that occur in the frail senior population. The health care providers have excellent diagnostic skills to recognize and

treat illness but lack understanding in how to deal with the complexity of the frail senior population. Symptom analysis in isolation does not allow the clinician to clearly define an elderly patient's problem because of the close interaction of the psychosocial and medical factors that affect the patient's ability to cope.

Emergency staff often feel inadequate looking after the elderly due to the complexity of their situations (Miller et al., 1996). Lewis et al. (1995) studied the sensitivity of the emergency physician's conventional evaluation to detect delirium in 385 elderly patients presenting at an urban emergency department and found that physicians were able to correctly detect delirium in only 17% of the cases. Kelly (1994) studied triage alternatives in the emergency department for nonurgent cases that could be treated at alternative health care sites. She found that nurses were not comfortable triaging the elderly population because they felt that this group was too complex for one discipline to assess. Therefore, all seniors were treated conservatively and reviewed by a physician.

The 1999 Alberta Government Policy Advisory Committee endorsed a comprehensive geriatric assessment (CGA) to be offered to all frail elderly persons presenting with an acute change in either illness or function. The older person who presents with one or more of the geriatric syndromes—including functional impairment, falls, urinary incontinence, cognitive impairment, and polypharmacy—gain the most benefit from a CGA (Keller & Potter, 1994; Shah, Maly, Frank, Hirsch, & Reuban, 1997; Sinoff, Clarfield, Bergman, & Beaudet, 1998). The CGA is completed by a team that has an interest and expertise in geriatric concerns (Alessi et al., 1997; Boult & Pacala, 1999; Fretwell, 1990). The geriatric process is composed of an assessment, the establishment of

a comprehensive data base, the development of strategies and management interventions, and follow up (Alessi et al., 1997; Boult & Pacala, 1999; Foley et al., 1992; Reuben, Fishman, McNabney, & Wolde-Tsadik, 1996). The goals of the comprehensive assessment is to decrease the person's functional decline (Alessi et al., 1997; Keller & Potter, 1994; Leveille et al., 1998; Shah et al., 1997), improve the person's quality of life (Keller & Potter, 1994; Shah et al., 1997; Sinoff et al., 1998), provide a through and accurate assessment of the problems (Keller & Potter, 1994; Silliman, McGarvey, Raymond, & Fretwall, 1990), link with the appropriate community service or care facility (Leveille et al., 1998; Silliman et al., 1990), and decrease the number of hospital admissions (Brymer et al., 1995; Stuck, Siu, Wieland, Adams, & Rubenstein, 1993).

The goal of all health professionals involved in geriatric care is to maintain independence and improve quality of life. To accomplish this goal clinicians must be aware of who is at risk of becoming dependent and what are the variables that put them at risk (Gill, Williams, & Tinetti, 1999). Unfortunately, it has been difficult to identify those seniors who are at the highest risk of health decline (Freedman, Beck, Robertson, Calonge, & Gade, 1996). Among health care professionals working in geriatrics, the term *frail* illustrates those seniors at risk. Brown et al. (1995) cautioned that the word *frail* is often used with no clear meaning and no established guidelines for treatment. Defining the indicators of frailty would prompt clinical consensus of who is frail and allow staff to develop strategies for management interventions. Focusing management strategies and resource delivery on a defined population is essential to achieve optimal health care delivery in the fiscal arena and to provide personalized patient care.

Conceptual Analysis of the Term Frailty

Throughout the literature and in clinical practice the term *frailty* is frequently utilized and very broadly defined (Caplan, Brown, Crocker, & Doolan, 1998). Frailty can occur at any age. Premature infants or young adults suffering with AIDS may be considered frail (Brown et al., 1995, Hammerman, 1999). The term is also used to describe an older senior population. Rockwood (1992) found that the usage of the words *frail* and *frailty* has increased throughout the geriatric literature from 13 citations in 1986 to 80 in the first nine months of 1992. The difficulty with the increased usage of the word is that there are no predetermined parameters in which the term can be utilized. This leaves the description of the patient to the clinician's subjective point of view. Brown et al. (1995) wrote that increased usage of the term attests to a strong need for a clear definition and conceptual framework that will

(a) provide function as a standard view of frailty, (b) clarify our understanding of frailty, (c) recognize the complexities of frailty, (d) offer a view of frailty that avoids stigmatizing individuals, (e) emphasize that frailty has many positive and hopeful aspects that are amenable to intervention. (p. 95)

Insight into the population identified as frail will prove to be beneficial in attempting to address which factors make these patients frail and which factors are reversible.

Conceptual clarity of the term *frail* has been difficult to obtain due to the multidimensional nature of the concept. Attaching the term to a specific outcome such as death, institutionalization (Rockwood et al., 1999), or falls (Speechley & Tinetti, 1991) limits the use to those areas alone. Describing it as a disability decreases the requirement to address prevention or treatment because it is seen as an endpoint (Buchner & Wagner, 1992). Strawbridge et al. (1998) suggested that a stronger definition can be conceptualized by reviewing the underlying themes in multiple studies completed on

frailty. The literature supported the idea that a multidimensional definition of frailty must include key components, interaction with the environment (Rockwood et al., 1994), pathological effects of multiple disease processes (Buchner & Wagner, 1997), and limitations in physical and social aspects (Speechley & Tinetti, 1991). For clinical purposes the definition and assessment of frailty needs to be terms that many health professionals in all areas of health care can understand and implement in their practice.

Indicators Used to Predict Frailty

Numerous indicators have been proposed throughout the literature as being predictors of frailty. Some authors defined frailty using age or disease as predictors (Boult et al., 1993; Hogan et al., 1999; Langlois, Norton, Caombell, & Leveille, 1999; Wu, Leu, and Li, 1999). Others focus on the lack of functional abilities with either activities of daily living or instrumental activities of daily living (Brown et al., 1995; Caplan et al., 1998; Freedman et al., 1996; Geasley, 1997; Leveille et al., 1998; Palmore, Nowlin, & Wang, 1985; Pressley & Patrick, 1999; Rosswurm & Lanham, 1998). Other authors felt that cognitive impairment is the main contributor to disability (Gill et al., 1999; Worrall et al., 1994). A few authors viewed frailty as a state that occurs in response to an acute change that is potentially reversible or manageable (Brocklehurst, 1985; Buchner & Wagner, 1992; Hammerman, 1999; Rockwood et al., 1994).

Age has been a marker in clinical practice for helping the clinician decide which services and treatment options should be pursued. Geriatric specialists across all disciplines have attempted to ignore chronological age and tried to focus on biological age. There are, however, recent studies that have used chronological age as a predictor of frailty. Hogan et al. (1999) utilized data from the Canadian Study of Health and Aging to

assess the effect of selected chronic medical conditions on the functional abilities of cognitively intact community-dwelling seniors. He compared the younger than 85 with the older than 85 age groups and that found the older group had twice the physical disabilities of the younger groups. Depression, stroke, and respiratory problems were significant disease risk factors for the younger group, but not for the older group. In the older group age was the only significant explanatory variable for functional disabilities. Hogan et al. stressed that the prevention of disease will not decrease the amount of disability in the older population because functional decline occurs mainly because of age. Langlois et al. (1999) found that age in the over-85 age group was a strong predictor of decline in ability to manage activities of daily living (ADL) tasks. Boult et al. (1993) completed a longitudinal cohort study of noninstitutionalized seniors and used a logistic regression analysis to identify risk factors for repeated hospital admissions. Eight factors were identified as predictors of needing hospitalization within four years; namely, older age, male, poor-rated self-health, availability of informal caregiver, the presence of heart disease or diabetes, a hospital admission during the previous year, and more than six doctor visits. Wu et al. (1999) looked at the incidence and predictors of chronic disabilities in managing activities of daily living. They compared social demographic, health status, adverse lifestyle choices, and leisure-time activities as predictors of chronic disabilities. Wu et al. suggested that sedentary older people are at the highest risk for functional decline.

Palmore et al.'s (1985) studies contradicted the findings that age is a predictor of frailty. At the completion of a 10-year longitudinal study of community-dwelling seniors, he found that decline among those over 85 is highly variable and that age alone cannot

predict level of function. Studies that have reviewed the health and functional status of those over the age of 85 have also shown great heterogeneity of this group (Hitt, Young-Xu, Silver, & Perls, 1999; Jylha & Hervonen, 1999). Hitt et al. completed a retrospective review of the health and functional status of centenarians and found that 89% of those over the age of 92 were living independently. He found that most of the people at this age have lived their lives in excellent health and have a fairly rapid decline at the end. Jylha and Hervonen also found the over-90 age group to be living mainly in the community, with little formal or informal support.

Using age as an indicator of frailty is limiting because the person's needs are not identified and further assessment must be completed before a treatment plan can be implemented. Chronological age is a marker for clinicians to be alerted to the potential vulnerability for loss of independence, but should not be the sole predictor of frailty because multiple other factors influence the well-being of an individual. Researchers have been starting to explore the use of functional measurement to define frailty (Geasley, 1997). Geasley compared two groups of seniors whom geriatric specialists described as frail against those whom the panel defined as not frail. The panel associated decreased ability to complete instrumental activities of daily living (IADL) and activities of daily living (ADL) with the more frail group. Pressley and Patrick (1999) found that adverse outcomes were more predictable in the community-dwelling senior when using scales for ADL/IADL than the number or types of diseases were. Freedman et al. (1996) used a mailed survey to predict hospital admissions and found that those participants who had heart disease or diabetes and who needed help preparing meals and assistance with mobility were at high risk for hospitalization. Gateau et al. (1992) used the IADL scale to

help predict cognitive decline in seniors and found that the IADL scores alerted them not only to cognitive disabilities, but also to disabilities such as arthritis or depression. Chaplin et al. (1998) reviewed patients over the age of 75 who were admitted to the hospital from the emergency department. They completed standardized assessments of function and mental and social status in an attempt to identify patients at risk for admission to hospital. They found that patients over the age of 75 were at greater risk of being admitted if they were dependent in the management of their instrumental activities of daily living; notably, finances, shopping, or transportation; and basic activities of daily living such as bathing, dressing, and managing stairs.

Cognitive status directly affects the person's ability to function independently and is a risk factor for admission to institutional care (Rockwood et al., 1994; Worrall et al., 1994). The relationship between dementia and frailty has not been clearly defined (Rockwood et al., 1994); however, a decline in cognitive ability directly affects the ability to manage IADL tasks such as using the telephone, procuring transportation, managing medication regimes, and handling finances, which affects their functional independence (Barberger-Gateau et al., 1992). Gill et al. (1999) found that impaired physical activity and decreased cognitive status are disabilities that affect a person's ability to recover from an acute medical condition. Worrall et al. compared seniors in the community receiving home care with those in the community not requiring services and felt that cognitive decline was a stronger predictor of the need for services. When looking at factors that place seniors at risk for increased dependence, cognitive abilities cannot be ignored.

The needs of the caregiver of an older person are now being recognized as an essential component of the patient's successful outcome (Rosswurm & Lanham, 1998). The impact of care on the caregiver has a direct relationship to the amount and type of services needed to support the person at home (Cohen, 2000), because caregiver stress is the major determinant of institutionalization (Donaldson, Tarrier, & Tarrier, 1998). Rosswurm and Lanham (1998) found the availability of an informal caregiver to be an asset for effective discharge planning from an acute care institution. Boult et al. (1992) found that having an informal caregiver was a predictive factor in determining the need for hospitalization. He predicted that this finding might be related to the fact that the elderly person had someone to seek medical attention. This is an advantage because early intervention gives the person a better chance for a more positive outcome. Social resources are important to the outcome and care of the frail elderly person, and one of the most esteemed resources is the informal caregiver.

Frailty has also been perceived as a temporary state that with proper treatment can be reversed (Brocklehurst, 1985; Brown et al., 1995; Buchner & Wagner, 1992; Gill et al., 1999; Hammerman, 1999; Rockwood et al., 1998). These authors strove for an operational definition of frailty that would identify physiological indicators that are reversible. Buchner and Wagner defined frailty as a loss of physiological reserve due to an acute condition. This acute change renders the person disabled for a limited time frame. Three components that are precursors to the development of frailty were identified as (a) a loss of ability to manage complex tasks, (b) decreased physical strength, and (c) decreased physical endurance. Control and management of these precursors will to some extent prevent frailty. Approaches to prevention include remaining active and

removing obstacles that prevent recovery once an acute insult has occurred. Brocklehurst defined frailty in terms of the maintenance of an equilibrium between the psychosocial and physical well-being of the person. In Brocklehurst's definition, frailty is precipitated by an acute event that can vary from a medical condition such as a disease state or a psychosocial event such as the death of a spouse. The ultimate objective is to prevent the breakdown from occurring or to deal with the breakdown once it has occurred.

Rockwood et al. defined the concept of frailty with a multidimensional focus in that there are various combinations of factors that put a person at risk for becoming frail. These authors further developed Brocklehurst's equilibrium model to include a more dynamic interplay of assets and deficits necessary to maintain independence. Adjusting the forces of various assets and deficits can manifest a change in status. A state of frailty occurs when "the assets maintaining health and the deficits threatening it are in precarious balance" (Rockwood et.al, 1994, p. 492). The assets in this model are attitudes towards health and health practices, resources and caregivers; the deficits are amount of disability, dependence on others and the amount of burden on caregivers. This multidimensional concept allows clinicians to take an active role in reversing factors that put the person at risk by supporting the areas of deficit. Brown et al. (1995) described frailty on a continuum in which the person may present as very frail to minimally frail. The person moves along the continuum depending upon the stresses and supports presently available. Frailty is nonstatic because a person can become more or less frail depending on life's circumstances and a person's reserve capacity. Reserve capacity is defined as the amount of energy a person can utilize to offset a crisis. This energy reflects the amount of functional decline a person will experience with an acute insult. The amount of functional

change a person experiences in relation to the insult is a determinant of their frail state. Those who are recognized as having a decrease in reserve warrants monitoring, and any health intervention that is implemented to increase this reserve will ultimately control the level of frailty the person may experience.

Hammerman (1999) explored a biological basis for the manifestations of frailty. He found that “frailty may represent the complex and cumulative expression of altered homeostatic responses to multiple stresses”(p. 948). Restoration of a normal metabolic state should be the therapeutic goal for all clinicians. Advocacy of health practices such as good nutrition and regular exercise that maintains a healthy metabolic state may promote preventative measures for frailty.

The multidimensional definitions of frailty provide a framework that allows a clinician to assess strengths as well as diminishing abilities and encourages optimism in the treatment plan, focusing more on reversibility of functional loss versus support of a disability.

Measuring Frailty

There is a strong agreement throughout the literature stating a need for a standardized tool to evaluate frailty. Brown et al. (1995) listed several strategies for use in the measurement of frailty. The first is that frailty needs to be described in terms of its components and the factors that contribute to it. These components include practical and social activities, personal and environmental factors that are common to the well-being of all people, and those activities that are specific to that individual. Frailty needs to be measured on a continuum to ensure that the diagnosis of frailty is not seen as an endpoint, and some intervention must be put in place to decrease the amount of frailty.

Measurement methods need to have the capability to measure both positive and negative changes over time. Assessing such differences would allow for the tailoring of interventions to meet the person's level of function. A definition of frailty must describe the age group which the term is being used to characterize. The assessment of the needs of the frail newborn differs from that of the needs of the frail senior, and the tools must be able to measure indicators specific to the age group it represents. In the senior population frailty should be considered in the realm of geriatric sciences, which includes assessment, treatment, and the maintenance of function.

One of the principles of geriatric medicine is the focus on the patient's functional ability. It is difficult to complete an accurate assessment of geriatric patients without comparing their present functional status with their status prior to their illness. In the acutely ill geriatric patient alternatives for care are estimated by looking at (a) functional ability prior to illness (Rockwood et al., 1994) and (b) rate of functional decline since the illness (Fretwell, 1990). The measurement of functional status is useful in planning medical and social treatment options (Chentz, 1991; Fretwell, 1990; Jarrett et al., 1995). Functional status has been a predictor of morbidity, long term care placement, rehabilitation potential, and disability predictors (Eliastam, 1989; Hogan et al., 1999; Judge, Schechtman, & Cress, 1996). The higher the level of premorbid function and the more timely the intervention, the better the prognosis for reversibility of functional decline (Fretwell, 1990). At the completion of the Canadian Study of Health and Aging, Hogan et al. (1999) emphasized that focusing on disease prevention will only partially decrease disability in the older age group. He stressed the need for health care delivery to focus on methods of preserving function as well as disease management in order to make

an impact on the maintenance of health of the over-85 age group. Carlson et al. (1998) looked at the term *functional homeostasis*, the ability of an individual to withstand illness without the loss of function. They completed a prospective study on acutely ill, hospitalized geriatric patients and found that change in functional status associated with an acute illness was a better predictor of adverse outcomes than was the actual level of function at discharge. Any tool that measures frailty in a senior's population will need to evaluate methods that will describe functional abilities.

Rockwood et al. (1999) developed a short candidate measure of frailty and used it to predict death or institutionalization in a community-dwelling senior population. The scale was derived from the classification scheme of the geriatric status scale used to predict which hospitalized patients needed a geriatric assessment. It included the following variables: mobility, ability to perform activities of daily living, bladder and bowel management, and level of cognition. Patients were classified as 0 if they were independent, 1 if they had bowel or bladder incontinence, 2 if they needed assistance with mobility or activities of daily living and had no cognitive impairment or incontinence, and 3 if they were dependent on one or more activities of daily living and were incontinent. The scale showed a dose-response relation between grades of frailty and institutionalization. The scale was able to predict adverse outcomes post discharge, but further testing is needed to assess the usefulness of the scale in identifying those patients who would benefit from an intervention.

Strawbridge et al. (1998) examined the predictors and prevalence of frailty among community-dwelling seniors during a three-year longitudinal study. They conceptualized frailty as having difficulties in two or more domains. Frailty was measured using 16

variables grouped to represent four domains: physical function, nutrition, cognition, and sensory difficulties. The frail person reported decreased daily activities, poor mental health, and lower life satisfaction. The cumulative predictors of frailty evaluated over three decades (1965, 1974, 1983) were increased alcohol consumption, the presence of two or more chronic conditions, physical inactivity, and depression. This study supported the necessity for prevention programs to modify the cumulative predictors to prevent the occurrence of frailty. Further research is needed to determine the usefulness of this screening tool in the clinical area to treat or reverse frailty.

Speechley and Tinetti (1991) completed an exploratory study to examine potential means to cluster a wide array of characteristics associated with falls. The representative sample included 336 community elders assigned to three groups: the frail, transitional, and vigorous senior population. They used the Principal Component Analysis to examine intercorrelation among characteristics in each group. Eighteen variables were used to represent five domains: sociodemographic, psychological, health and function, medication use, and physical symptoms or impairments. The factors that were predominant for the frail group included age greater than 80 years, cognitive impairment, use of sedatives, poor vision, and sedentary lifestyle. The purpose of their study was to determine who should be targeted for a fall-prevention program and may not be applicable to all clinical areas.

Paw et al. (1999) examined three working definitions of frailty for selecting a frail population. They defined frailty as inactivity, combined with low energy intake, weight loss, or low body mass. They studied 450 elders over a three-year time frame and found that differences among the inactivity and weight-loss criteria were more pronounced than

the other categories of inactivity and low energy intake, and inactivity and low body mass. The advantage of this screening tool is the simplicity of monitoring two variables, weight change and activity level.

Brody et al. (1997) investigated the utility of a self-reported screening instrument to predict frailty in a seniors population living in the community. Their definition of frailty was a condition in which any person requires long-term care within a year of completing the questionnaire. The markers of frailty included ADL, IADL abilities, number of prescription drugs, age, health status, number of hospital admissions, use of special equipment such as walkers or wheel chairs, type of housing, and admission to an acute care facilities. They found that age, the effect of medical conditions on the person's ability to manage his/her basic activities of daily living, the need for assistance with bathing, and the dispensing of medications were the most common markers of frailty in the senior population. One of the weaknesses of this study is that, with a self-reporting tool, the study is limited to only those candidates who are cognitively capable of completing the questionnaire. Those who have decreased cognitive abilities would be eliminated. Because cognition is a large factor to consider when caring for seniors, this would eliminate a very prevalent group of subjects. Further research is needed to test whether these four variables would independently screen for frailty and also to assess whether applying an intervention would decrease the need for long-term institutionalization.

McCusker et al. (1999) developed a self-reporting screening tool, named the ISAR (Identification of Seniors at Risk), for those patients who were admitted to the emergency department. The scale was used to determine who would be at risk for adverse

health outcomes including death or institutionalization, admissions to hospital, or significant decrease in functional status. The scale measures 27 questions on social, physical, and mental factors. The ISAR was reported to identify older patients at risk of several adverse health outcomes. The score correlated strongly with those patients who had significant disability and required increased care. The results of the study do not clearly state the internal consistency of the scales, so it is difficult to assess whether all the questions measure the degree of frailty or if some are interrelated. The limitations of this study are similar to those in Brody et al.'s (1997) study due to the assumed level of cognitive abilities that is required to complete the form. Because the questionnaire is limited to a yes or no response, there is no measurement of the level of dependency of the person; therefore, it is difficult to measure change or degrees of frailty. The authors did not clearly define the outcome labeled "clinical significant decrease in function," making the level of frailty of their population hard to determine. The authors stated that the tool has been validated for use in the emergency department, and further testing is needed to determine other areas of clinical care where it could be utilized.

Implications for Practice

Promoting wellness and independence in the senior population has great social and economic implications for utilization of health care resources. The most important means of promoting wellness in seniors is to offer early intervention to those who are in danger of losing their independence. Adoption of the concept of frailty as a temporary state of dependence allows health care professionals to focus on what is reversible rather than seeing the person as being too disabled or impaired to warrant therapy. A shift in the focus of care from disease management to preserving functional abilities will have a

greater impact on a person's quality of life than strictly symptom control. It would be advantageous to have markers of frailty that are reliable and valid to detect changes in functional status. Such a scale could be used to alert the caregiver of any change so that the appropriate intervention is applied. The use of a standardized tool also allows clinicians to communicate effectively the needs of the patient among different disciplines, enabling a team of professionals to coordinate a plan and effectively monitor a patient's progress. Research is needed to identify dynamic markers of frailty so that early intervention can be promoted to reverse functional decline promptly. The tool needs to be applicable to all levels of expertise. All professionals, including personal care attendants, must feel confident utilizing the tool because geriatric services rely on these professionals to refer patients. Previous studies have looked at all components of frailty, making the screening tools long and difficult to complete. Key variables that strongly predict frailty need to be identified to ensure that the questions are kept at a minimum. This study will review an outpatient senior population that has been deemed frail by geriatric clinicians to determine which indicators of frailty best predict who is at risk for experiencing a decline in health status that will affect their ability to remain independent.

CHAPTER THREE

RESEARCH METHODS

This study analyzed the structure of the relationships among 26 variables to determine key variables that could be used as key predictors to measure the concept of frailty. The study population comprised of seniors refers to an outpatient geriatric assessment clinic who were experiencing an acute change (within six weeks) in their ability to manage in the community. The clinic population, from the Capital Health region as well as neighboring areas, constituted a good representation of seniors who are frail and have potential to improve. All clinic charts for the time frame August 1996 to December 1999, including a total of 2,505 charts, were reviewed.

Definition of Terms

For this study the conceptual framework described by Brown et al. (1995) will be used. In this framework frailty is seen as occurring on a continuum in that a person can become more or less frail with interventions or stress. Frailty will be viewed as a dynamic state in which a person experiences dependence in his/her ability to manage activities of daily living due to intrinsic or extrinsic stress. The measurement of frailty will include the activities that a person must carry out for daily survival.

Variables of frailty: The three domains of functional abilities, pathological stresses, and social supports are described, using 26 operational variables measured in a frail senior outpatient clinic.

Functional ability: The basic activities of daily living include personal care, dressing, feeding, bathing, managing stairs, bladder and bowel control, mobility, and transferring. The instrumental activities of daily living include use of the

telephone; planning leisure activities; having the ability to read; preparing meals; administering medications; managing transportation issues; completing banking; going shopping; doing laundry, housework, and house maintenance. Cognitive abilities will be recorded using MMSE scores, where a score of 24 or less is indicative of some cognitive impairments.

Physiological stresses: Physiological stresses include the age of the person and the number of chronic medical concerns the person is experiencing. The systems include respiratory, cardiac, neurological, gastroenterology, urology, and integument.

Social supports: Social supports measure the amount of support the person requires. The presence or absence and number of informal and formal caregivers are identified.

Study Population and Setting

The Seniors Clinic at the University Hospital of Alberta in Edmonton, Alberta, was designed to provide services to seniors who are experiencing a decline in physical, cognitive, or psychosocial function; or who have multiple medical and/or pharmaceutical problems preventing them from coping in the community. The clinic offers a timely interdisciplinary consultation for seniors referred from emergency departments and the community. Each patient referred to the Seniors Clinic at the University of Alberta Hospital site of the Capital Health Authority is reviewed by a geriatric interdisciplinary team comprised of a nurse, a physical therapist, an occupational therapist, a social worker, a licensed practical nurse, a pharmacist, and a physician. The assessment tools used by the team include the Mini Mental State Examination (MMSE) as a cognitive screening tool, the modified Barthel as a measurement of activities of daily living (ADL),

and the Assessment of Living Skills and Available Resources Scale (ALSAR) as a measurement of the instrumental activities of daily living. Available demographic data including age, number of informal and formal caregivers, and number of medical concerns were also collected.

To ensure that the Senior's Clinic population was accurately defined as frail, the characteristics of this study population were compared to the population studied in other studies that analyzed frailty. The population attending the clinic were compared to the community-based patients that were recruited for the Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) studies were designed to measure different interventions in selected frail senior populations. There were eight clinical trials that recruited community-based subjects between 68 and 75 years of age who were independent, with ambulation, had the ability to walk eight meters unattended, had MMSE scores between 24 and 20, and had an average of 3.7 chronic conditions. In the Seniors Clinic population the average age of clinic patients was 84 years. A larger portion of the population, 64%, was female; and men formed 36% of those served. The majority of the women were widowed (55%), whereas the majority of the men were married (62%). Of these seniors, 75% had one informal caregiver, 60% of whom were identified as a family member and 16% as spouses. Fifty percent were receiving formal caregiving support in the community, with home care being the most common, at 41%. Patients had an average of four medical concerns per assessment. With the patients who completed a Mini-Mental State Examination, the average score was 23. Forty-four percent had a Barthel score of 90-100, indicating independence in basic care. The most common dependencies were bathing (43%) and managing stairs (53%). ALSAR measurements

showed a dependence in transportation (42%), shopping (43.9%), meal preparation (46%), laundry (50.9%), housekeeping (54%), and home maintenance (78.4%). Compared to the selected community population for the FICSIT study (Mangione, 1995), the Seniors Clinic population did appear older and had more chronic conditions and lower MMSE scores. This indicates that, when comparing these indicators, the Seniors Clinic population represented a frail group. A comparison of the study population characteristics of the FICSIT study and this study is demonstrated in Table 3.1

Table 3.1

Comparison of frail subject characteristics between FICSIT and Seniors Clinic

Study	Average age	Number of chronic condition	Ability to ambulate	MMSE score
FICSIT	68-75	3.7	Independent	24-20
Seniors Clinic	84	4	Independent	23 average

Note: variables such as gender, ability to manage their own instrumental activities of daily living, number of formal and informal supports were not routinely measured in all nine studies and therefore was not included in the comparisons.

The population attending the clinic is similar to the community-based patients who were recruited for the FICSIT studies, supporting the idea that the Senior's Clinic population represents a frail senior population.

Design

An exploratory descriptive approach, was employed to reveal patterns of relationships among the variables associated with the concept of frailty. Due to the complexity of the concept of frailty, there are many observable variables, making it difficult to determine the key variables needed to measure the term accurately. Factor analysis was applied to items of the assessment instruments to describe the observed correlation of variables and to identify the key factors which describe frailty. The predictability of the results of the factor analysis in determining different levels of frailty was tested with direct discriminant analysis. Using Brown et al.'s (1995) definition of frailty, 26 variables were identified that accurately measure the three domains of function, pathological stresses, and social supports. The following measurement instruments were used in the data analysis.

Assessment Instruments

Mini Mental State Examination

The geriatric assessment in the Seniors Clinic includes use of the MMSE (see Appendix A) as a cognitive screening tool. The MMSE was developed by Folstein, Folstein, and McHugh in 1975 and has become a universal tool for screening of cognitive abilities in the older adult. It takes approximately 10 minutes to administer and can be used by a variety of professionals. The MMSE has two sections, one requiring verbal responses addressing orientation, memory, and attention; and the second testing the ability of the individual to follow verbal and written commands. Detailed instructions are given on completing each task, and there is no time restrictions. Folstein et al. demonstrated that a score of less than 20 out of a maximum of 30 in an older adult was

indicative of some cognitive impairment. Further testing completed by Ashford, Kolm, Colliver, Bekian, and Hsu (1989) led to the use of the MMSE to grade the severity of a senior's cognitive impairment. Mild cognitive impairment was categorized as an MMSE score above 20, moderate impairment as between 11 and 19, and severe impairment was found in the 10 and under group. This grading scale has been in use in the clinical area as a marker of cognitive impairment. The MMSE was originally tested in 69 patients with dementia or depression or both. (Folstein et al., 1975). Folstein et al. tested for concurrent validity with the Verbal and Performance Intellectual Quotient of the Wechsler Adult Intelligence Scale, which yielded a Pearson r of 0.776 ($p.= 0.0001$). The MMSE was found to be reliable both with multiple examiners and over time with a Pearson coefficient of 0.887. The MMSE is thus believed to be a valid test of cognitive function that is capable of identifying those with cognitive difficulties. A license to use the MMSE for this research project was purchased.

The Assessment of Living Skills and Available Resources

The ALSAR (see Appendix B) was developed by Williams et al. (1991) to examine an elderly person's ability to complete 11 tasks associated with the IADLs. The tasks include using the telephone, reading, leisure activities, medication management, meal preparations, shopping, financial management, laundry, house maintenance, housekeeping, and transportation. The ALSAR reviews the skills required to complete these tasks and identifies the availability of resources to support them. This information allows the clinician to determine a risk score predictive of level of independence. There are ratings of independence, partial independence, and total dependence in completing the tasks, which are scored as 0, 1, 2, respectively. In the resource column a score of 0

indicates that there are adequate resources available, 1 means that the resource is occasionally available, and 2 means that the resource is consistently not available.

Williams et al. (1991) defined risk in terms of a deficit in either skills or resources and obtained a risk score by combining the skill and resource score for each task. A score of 3-4 is indicative of a high risk, 2 is a moderate risk, and 0-1 is a low risk. The higher the total risk score, the greater the risk of dependence.

The ALSAR was administered to 75 patients enrolled in a home care program from Middleton Memorial Veterans Hospital in Madison, WI. The 11 ALSAR risk scores for skill and resources demonstrated a high reliability, as reflected by a Cronbach's alpha value of greater than .90. Interrater reliability was 86% on skills and 95% on resources. The R-score significantly correlated with the MMSE and the Barthel Index and demonstrated predictive value in determining who was at risk for needing nursing home placement and hospitalization. Williams et al. (1991) used the R-score to prioritize and optimize clinical care of frail elders.

The Modified Barthel

The Modified Barthel Index (see Appendix C) measures performance on ADL functions. The ADL tasks include personal hygiene, bathing, feeding, toileting, managing stairs, dressing, bowel control, bladder control, ambulation/wheelchair, and chair and bed transfers. The Barthel index has three scoring categories, including ability to perform the task, needs assistance, and totally dependent. Using the same parameters Shah, Vanclay, and Cooper (1989) developed a more graduated scale to be more sensitive to change in functional status. The modified scoring system has five categories for grading ADL activities: unable to perform task, attempts task but is unsafe, moderate help required,

minimal help required, and fully independent. The modified scale was used with 258 stroke patients and yielded a Cronbach's alpha of 0.90. The total scoring on the modified Barthel Index is shown to relate to the type of accommodation the person will need and provides a suitable measure of total functional independence. A score of 0-20 suggests total dependence; 21-60, severe dependence; 61-90, moderate dependence; and 91-99, slight dependence. A score of 100 indicates that the patient is independent. The original Barthel index demonstrated a high content reliability with a Cronbach's alpha value of 0.87, which was increased to 0.93 using the five-point scoring system. The internal reliability was calculated at a Cronbach's coefficient of .90. Authors' permission was obtained to use this index for this research project.

Data Collection

The data from the charts were entered onto an Access database and exported to SPSS statistical program, version 10. All subjects were identified by file number. The charts were kept in a locked chart room in the clinic area. The computer with the stored data was accessible only to selected members, such as the researcher, thesis supervisor, and members of the thesis committee. The results were pooled, and no health care numbers or personal patient-identifying data were used.

Sample Size

There are no power tables available to calculate the number of subjects with factor analysis. Sample size depends on the number of items on each factor, the average strength of the factor loading, and the commonalities of the items (Norman & Streiner, 2000). The recommendation is that there be a minimum of five subjects per variable, with a total of at least 100 subjects if the commonalities are high and there are many variables

per factor. If these two conditions cannot be met, then the subject variable ratio and number of subjects should be doubled to 10 subjects per variable, with a total of 200 subjects. In discriminant analysis the sample size of the smallest group should exceed the number of predictor variables (Tabachnick & Fidell, 1989). Because the number of predictor variables at this time is not known, this will be calculated with the factor analysis results. The total number of charts reviewed was 2,505, an adequate number to represent the 26 variables being analyzed (Norman & Streiner, 1999).

Procedures

The goal of this study was to explore the relationships among the 26 variables identified as predictors of frailty and to see whether these predictors could be reduced to a more manageable size. One of the aims in analyzing the structure of a questionnaire for internal consistency and reliability is to ascertain whether the interrelationships found among the observed items can be explained by a small number of underlying, unobservable factors or dimensions. To answer this question, the statistical technique of a factor analysis was completed.

Factor Analysis

“Factor analysis is a statistical technique used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables.” (Norusis, 1990, p. B125) Factor analysis was used to eliminate those variables that were redundant. The first step of the analysis was to compute the correlation matrix for all variables. The correlation matrix summarizes information from the raw data. The data were coded so that all variables from each of the tools were converted to standard scores. An increased score indicated increased dependence or

frailty. Only the scores for the individual components of the ALSAR and the BARTHÉL were used. The total scores of these tests were not calculated into the factor analysis. A low score on the task being evaluated indicated a low level of dependence, and a high score indicated a high level of dependence in completing the task. Similar coding was used with recording the MMSE scores. A low score was given for high points on the MMSE and a high score for low points on the MMSE. For example, a person who had no cognitive impairment and scored a perfect 30 would have a zero because they were not dependent in their cognitive skills. The amount of social support was also scored low, indicating that no assistance was needed, and higher scores indicated that multiple assistance was necessary. Chronic concern was standardized, with an increase in the number of chronic conditions indicating an increase in frailty. Age was recorded as raw data because increased age has been associated with increased frailty. A Barlett Test of Sphericity and a Kaiser Meyer Olsin test was run to determine whether the correlation matrix differed significantly enough to continue with the analysis.

The second step of the factor analysis was completed to determine whether the interrelationships found among the observed items could be explained by a small number of underlying, unobserved factors or dimensions. This was computed using the principal component analysis method. With principal components analysis, all variables have equal weight; thus it is not predetermined as to which variables should be included or excluded. Because it is unclear which of the 26 variables will have the most influence on the measurement of frailty, principal components analysis was the method of choice. Factors were extracted by looking at either the factor eigenvalues (total number of variance explained by a factor) or the sum of variance accounted for by individual factors. Those

factors that account for at least 5% of the variance were included. The rotation phase allowed the initial matrix to be interpreted into factors that are substantially meaningful. A varimax method, which allows for maximum variance, was used. An orthogonal rotation was chosen, because factors in this study were uncorrelated. This is the most useful rotation when the intent in using factor analysis is for instrument development, because this type of rotation is easier to interpret (Munro, Visintainer, & Page, 1986).

The final stage of the research tested the predictability of the results of the factor analysis in determining frailty in a seniors population. Direct discriminant analysis was used to evaluate the predictability of the factors in classifying subjects according to three discharge dispositions. These included those individuals who were able to return home without any additional services, those returning home with additional services and those needing hospitalization. The definition of frailty identified by Brown et al. (1995) as the “diminished ability to carry out the important practical and social activities of daily living” (p.95) was used. The assumption fundamental to using discharge status as a means of distinguishing between the more and less frail was that those returning home without services were the least frail of the group because they could manage independently. Those needing increased home assistance were considered to be moderately frail because they were in need of some assistance to remain at home, whereas those requiring hospitalization were the most frail because they could not be maintained in their homes even with maximum community services in place.

Discriminant Analysis

Discriminant analysis allows the researcher to distinguish among groups with the use of predictor variables (Munro et al., 1986; Tabachnick & Fidell, 1996). The primary goals of discriminant analysis are to define the dimensions along which groups differ and to find classification functions that will predict group membership. In this study discriminant analysis was used to determine whether a diagnosis of mild, moderate, or severe frailty can be specified using a set of predetermined predictors. The predictors were chosen as a result of the principal components analysis.

Because frailty is a complex concept, the emphasis in this study was interpreting combinations of predictors that separate the group membership. This was accomplished by calculating multiple discriminant functions (Munro et al., 1986; Tabachnick & Fidell, 1996). The maximum number of discriminant functions that can be derived is one less than the number of categories of predictors or one less than the number of groups. Thus, in this study there were three possible groups representing degrees of frailty; therefore there is a possibility of two discriminant functions. One set of discriminant function coefficients is calculated for the first discriminant function and a second set for the second function. The first discriminant function provides the best separation among the groups, and each subsequent functional discriminate is run orthogonal to the first, separating those that are not used in the first function. The strength of each function is also evaluated by identifying the percentage of variance between the first function and each consecutive function. A Wilks' Lambda test is used to measure association between the predictors (independent variable) and the groups (dependent variable). As each successive discriminant function is added, a Wilks' Lambda test is calculated. The

association between the independent and the dependent variables decreases the closer the Wilks is to one. The discriminant functions are calculated on a matrix of indices of discrimination between and within groups. The analysis discriminates between the subjects in the groups (Munro et al., 1986). Predictors loading on the first function are listed first and are considered to demonstrate the largest correlation between the variable and the discriminant function. Structure coefficients of 0.30 or greater are considered meaningful (Tabachnick & Fidell, 1996). Because the interest in this study is the overall relationship between the predictors and groups, direct discriminant analysis was used so that all predictors would enter the equation at once. With direct discriminant analysis all discriminant functions are combined, and groups are considered simultaneously (Tabachnick & Fidell, 1996).

Classification is an extension of discriminant analysis that assesses the strength of each of the predetermined functions in their ability to predict membership into defined groups. A prior probability is calculated that determines the likelihood of ending up in a specific group by chance alone. This is an important calculation when the groups are not of equal size because it describes a prediction range that the function's predictions should exceed. The analysis of group membership, predicted group membership, and total group membership allows for the evaluation of which groups the predictors classify correctly and the overall percentage of success.

Ethical Considerations

Permission to access data from the clinic charts was obtained from the Health Ethics Review Board, Panel B, of the University of Alberta and Capital Health Authority. Only those variables that were relevant to the study were analyzed. No names or other identifying information of the patient, such as personal health number, address, or telephone number, was recorded. There was no direct benefit or perceived risk to those patients whose chart records were accessed.

Letters of permission for use of the database and assessment tools is included in Appendix D.

CHAPTER FOUR

RESULTS AND DISCUSSION

The database was evaluated, and the cases with missing variables were eliminated. The results of the factor analysis were reviewed to analyze the correlation matrix for uniqueness and commonalities of each of the 26 variables. The weight of the variables was determined using principal components analysis, which yielded three factors that were rotated using varimax orthogonal rotation to interpret the distribution of variance of each of the factors, the factorial complexity, the magnitude of the loading, and the unipolarity of the factors. The relevance of each factor in predicting a state of frailty was evaluated using discriminant analysis. Three subgroups of the study sample based on discharge status, including home-without-home-care services, home-with-home-care services, and hospitalization, were used to determine different levels of frailty.

Evaluation of the Data Base

Default markers were inserted in the clinic data to minimize the types of errors that could occur with data entry. For example, when a subject's Barthel score was recorded, there were only five choices available. This reduced the risk of entering abnormal values that might affect the total mean. The clinic database also contained a large pool of information that was not relevant to this study. The 26 variables identified in the literature as indicators of frailty were separated from the main data base and examined for anomalous values. Frequency tables were run on all the variables to identify possible outliers. Age was the only variable that had visual outliers, where one person was entered as 15 years old and another as 1,802. These cases were eliminated from the data. No other variables showed results that indicated incorrectly entered data values.

Missing values were eliminated listwise, and thus the cases with missing values for the factor variable were eliminated from the database. The total number of missing cases for the Barthel variables was 452 (18%); for the ALSAR variables, 174 (15%); for the total chronic conditions, 290 (11.6%); for the total number of informal caregivers, 82 (3.3%); for the total number of formal caregivers, 82 (3.3%); for age, 129 missing (5.1%); and for MMSE, 1,197 (47.8%). The number of valid entries was 1,008. Because the largest number of missing cases involved incomplete MMSE scores, a group comparison looked at those individuals who had MMSE scores completed and those who did not. The two groups were compared by analyzing the means of the variables chosen to predict frailty. The variables included age, total chronic conditions, total informal caregivers, and total formal caregivers. The total scores for the Barthel and the ALSAR were used instead of individual items in order to provide a more concise description of the subject.

T-tests for independent samples were completed to determine the differences in means in the group with the missing data and those with completed data on the variables specified above. T-tests showed no significant differences in the age of the subjects in either group. For the group with complete data, the mean age was 80.1; and for the group with incomplete data, the mean age was 79.6 ($p>.135$). The total number of chronic conditions did not vary between groups at 3.37 for complete data and 3.32 for those with missing data ($p>.811$). The study samples between the two groups are very similar in age and number of medical conditions, indicating that both groups are an equal representation of frailty when these two variables are compared. The total number of informal caregivers was .86 for the group with complete data and .76 for those with missing data.

Results for this group were statistically significant ($p>.000$). The total number of formal caregivers for the complete data group was .499 and for the missing data group was .424. This was also a statistically significant finding ($p>.000$). An increase in the number of formal and informal caregivers would indicate that the completed data group were in need of more support. The total Barthel score was 85.6 for the complete data group and 80.98 for the missing data group, also a statistically significantly finding ($p>.000$). An increased score on the Barthel indicates that the person is more independent in managing personal care. There was a statistically significant difference between the groups on the functional measurements of the Barthel because those in the missing data group were more dependent than those in the complete data group. Although there was a statistically significant difference between the groups, according to the suggested interpretation of the assessment tool, the clinical significance of the score does not indicate difference in functional ability. The scores of the Barthel are categorized: A score of 0-20 indicates total dependence; 21-60, severe dependence; 61-90, moderate dependence; 91-99, slight dependence; and 100, total independence (Shah et al., 1989). Using the authors' classification system, both groups would be classified in the moderate dependence category. The total ALSAR score was 9.34 for the complete data group and 7.86 for the missing data group, not a statistically significant result ($p>.394$). These scores indicate that both groups were dependent in accomplishing some of the tasks of their instrumental activities of daily living. The level of support differs according to the type of task with which the person needs assistance. For example, someone who needs help with meal preparation will need more support than the person who is in need of assistance with grocery shopping. The ALSAR tool allots the same score for each task, regardless of its

complexity. Therefore it is difficult to determine degree of dependence with a general score. The general score is useful in describing a broader description of the person's level of need.

There were statistically significant differences between the two groups on the variables of informal caregivers and formal caregiver support. The higher level of social support, both formal and informal, for the complete data group likely indicates that the subjects in this group were in need of more support than were those in the missing data group. The reason for the additional support required in the completed data group remains unclear because the two groups are similar in age, chronic conditions, and functional ability. The differences between the two groups with formal and informal support would indicate that the group without a completed MMSE was not as dependent as the group with a completed MMSE. Thus, it can be concluded that the group with the missing MMSE score that was eliminated from the database was more independent than the completed MMSE group, leaving a more dependent group for analysis. The summary of the data for the independent t-test is provided in Table 4.1.

The reasons for the noncompletion of the MMSE test were that the individual was too ill to complete the test, the person refused (common with people experiencing late moderate to severe dementia), or the clinician completing the assessment did not feel that the MMSE was essential because the person was cognitively intact. The number of patients who would have been too ill to complete the test may be reflected in the number of patients admitted to hospital from the clinic. This is a small proportion (10%) of the total population. The reason for those refusing to complete the MMSE, possibly due to severe cognitive impairment, would also be low because the number of subjects with an

Table 4.1

Independent T-Test for Two Groups on Completed MMSE Scores and Missing MMSE Scores

Variables	MMSE group	Mean	F	Sig.
Total Barthel	Complete data	85.6	68.1	.000
	Missing data	80.9		
Age	Complete data	80.1	2.23	.135
	Missing data	79.6		
Total informal support	Complete data	.86	37.6	.000
	Missing data	.77		
Total formal support	Complete data	.50	25.0	.000
	Missing data	.42		
Total ALSAR	Complete data	9.34	.770	.380
	Missing data	7.86		
Total chronic condition	Complete data	3.37	.057	.811
	Missing data	3.32		

MMSE score of 0-10 was only 2.3%. A score on the MMSE of 10 or less is a marker for moderate to severe dementia (Reisberg, Ferris, deLeon, & Crook, 1992). The third group, in which the clinician did not complete the MMSE because he/she considered the subject to be cognitively intact, was estimated to comprise the largest portion of the missing data group. This group may include subjects who are more cognitively intact than the subjects in the completed data group. The definition of frailty chosen for this study was diminished ability of a person to carry out the activities of daily living that are important to them (Brown et al., 1995). The purpose of the study was to identify the variables most commonly cited in the literature to determine how these variables interact both as a group and individually to influence level of frailty. Those seniors who were not cognitively

impaired may not truly represent the most frail subjects attending the clinic. The elimination of the higher-wellness seniors ensured that the remaining population was the most frail of the study population and allowed for a reasonable assessment of a more homogeneously frail group. The remaining cases were retained for the factor analysis.

Factor Analysis: The Correlation Matrix

A correlation matrix was developed to identify the correlations between the variables established in the identity matrix. The correlations were further tested with an anti-image correlation matrix, Barlett's test of sphericity, and Kaiser's measure of sampling adequacy. The values of the 26 variables were analyzed to determine the degree of correlation and the strength of each variable's unique contribution to the group (Norman & Streiner, 2000).

Identity Matrix

Preliminary analysis of the identity matrix demonstrates correlations higher than .30 on a number of variables. A correlation of .30 or greater is recommended for factor analysis to be effective (Norman & Streiner, 2000). The MMSE, had the highest correlations with the IADL variables, particularly the ability to manage medications (.414), use the telephone (.421), manage money (.352), and prepare meals (.300). This correlation between cognitive and functional abilities was expected because the ability to manage IADL tasks requires the highest cognitive functioning. Therefore a decline in cognitive abilities will directly relate to the ability to skillfully perform the activity. The results in this analysis are similar to those reported in the study by Barberger-Gateau et al. (1992) that demonstrated a correlation between cognitive impairment and

- (a) telephone use, (b) procuring transportation, (c) medication management, and
- (d) money management.

The results in this study revealed lower correlation between MMSE scores and the ability to perform basic activities of daily living (BADL), with the highest correlation being in the ability to perform personal hygiene (.320). This can be readily explained by the fact that basic activities of daily living are usually the last to diminish with a decline in cognitive function and would not be detected unless MMSE scores were lower than 15 (Reisberg et al., 1982). Eighty percent of the subjects had MMSE scores that were indicative of mild cognitive impairment. Thus, this level of impairment would not necessarily have had an effect on the ability to complete their basic activities of daily living. The poor correlation between the cognitive assessment scales and activities of daily living scales was also supported in the literature (Solomon et al., 1999).

The IADL measurements had high correlations among the different variables that were components of this scale. The highest correlations among the items included (a) the ability to use the telephone with reading (.54), (b) reading with planning leisure activity (.56), (c) medication management with money management (.61), (d) money management with transportation procurement (.64), (e) transportation with shopping (.67), (f) meal preparation with laundry (.70), and (g) laundry management with housekeeping (.79). These strong correlations among the variables of the scale alert the researcher to the possibility of successfully reducing the number of assessment questions without losing clinically significant information. Interitem correlation should average between .30 and .70; any correlation above .70 implies redundancy (Brink & Wood, 1994). The ability to manage the laundry relates highly to housekeeping (.79). Therefore,

the two skills may be able to be assessed in a single measurement. Further research is needed to test reducing the number of items in the scale. Home maintenance did not reveal particularly high results with any of the items. The highest correlation was in relation to housekeeping tasks (.47). The ability to maintain the home may be a unique task that cannot be eliminated. All of the remaining items have a high correlation, indicating that the variables measuring IADL skills strongly correlate, which supports continuing with the factor analysis.

The BADL scores also showed high correlation among some of its components. The strongest relationship was between (a) personal hygiene and dressing (.74), (b) bathing and personal hygiene (.73), (c) feeding and personal hygiene (.68), (d) toileting and transferring (.74), (e) stairs and bathing (.57), (f) dressing and personal hygiene (.74), (g) bowel and bladder management (.71), and (h) ambulation with transferring (.66). However, the BADL items showed lower correlation with the items associated with IADL skills, with the highest readings being between bathing and laundry (.36), personal hygiene and using the telephone (.39), and personal hygiene and leisure (.38). Personal hygiene did show a correlation of $>.70$ with the tasks of dressing, bathing, and feeding. There was also a high correlation (.70) between bowel and bladder management and toileting and transferring. Therefore the redundancy of questioning all individual tasks needs to be further evaluated. The results of correlation matrix looking at the Barthel items support the continuation of completing the factor analysis.

Formal caregiver support showed a correlation with housekeeping (.301). This relationship may be an indication of the amount of privately hired assistance rather than the amount of government-sponsored support through such agencies as home care.

Obtaining housekeeping services through home care is rare because their services are usually focused more towards personal care tasks, particularly bathing. Bathing showed a correlation of .306 with the formal caregiver variable. The poor correlation between informal caregiver support and all other variables is surprising because the presence or absence of a family member is often considered a strong indicator for successfully managing at home (Rosswurm & Lanham, 1998). Boult et al. (1999) found that elderly people had a safety net with the availability of an informal caregiver, allowing for early medical intervention. The relationship between informal caregiver support and the reason for accessing the clinic or timeliness of accessing the clinic was not documented. Because all referrals to the clinic originate from formal agencies such as emergency, home care, or family physician, the influence of the informal caregiver in pursuing assistance could not be measured.

The total number of chronic conditions did not correlate highly with any of the variables. This was surprising, because most of the literature has used chronic medical conditions as indicators for frailty (Boult et al., 1999). However, it is likely that the reason that chronic conditions did not correlate with the other variables may be that only the number of illnesses was recorded, not the status of these chronic illnesses. Therefore, although individuals in the study may have had a number of co-morbidities, the effect of the disease process on ability to cope did not appear discernable. Thus, the use of the number and types of chronic disease to measure frailty is not as effective a marker as disease status because of the diverse types of pathological effects that these diseases may have on an individual (Buchner, 1999; Pressley & Patrick, 1999).

Age did not correlate with any variable, a finding that is not entirely surprising because its relationship with frailty is quite controversial. Some studies supported the concept of chronological age as a strong predictor of frailty (Brody et al., 1997; Hogan et al., 1999), whereas others did not find this to be so (Hebert, Bravo, Bitensky, & Voyer, 1996; McCusker et al., 1999). Because seniors are such a heterogeneous group, age alone may not be a significant predictor of frailty. In any case, because the subjects who attended the clinic were primarily in the older-senior age category, there may not have been a large enough variation to detect the impact of advancing age. However, strong correlations among other variables provided an indication that the variables chosen for the factor analysis were relevant and required further analysis. Results of the correlation matrix are shown in Table 4.2.

Anti-Image Correlation Matrix

To test commonalities in the variables, a Barlett Test of Sphericity was completed. The Barlett Test of Sphericity yielded a chi square statistic of 14071.8 ($p > .0000$), indicating that the correlation matrix and the identity matrix differed significantly. A Kaiser-Meyer-Olkin Measurement of Sampling Adequacy (MSA) based on the squared partial correlation was calculated. This test assesses the overall adequacy of the matrix and identifies which of the variables have the greater statistical weight. A value of less than .50 would indicate that the variable shows low statistical weight and does not contribute to the uniqueness of the factors, and therefore it can be eliminated (Norman & Streiner, 2000). The overall MSA score for the entire analysis yields a coefficient of .923, indicating that the majority of variables did demonstrate that they had both similarity and singular values. The variables showing the highest statistical weights

Table 4.2

Correlation Matrix for IADL and BADL Items

	Age	Chronic	Informal care	Formal care	MMSE	Phone	Reading	Leisure	Meds.	Money
Age	1.00	.06	.02	.13	.16	.02	.09	.04	.07	.06
Chronic condition	.06	1.00	.07	.06	.09	.12	.16	.17	.20	.28
Informal care	.02	.007	1.00	.11	.11	.12	.16	.17	.20	.28
Formal care	.13	.06	.11	1.00	.108	.13	.18	.21	.26	.25
MMSE	.16	.09	.11	.108	1.00	.42	.35	.30	.41	.35
Phone	.02	.02	.12	.13	.42	1.00	.54	.46	.49	.40
Reading	.09	.003	.16	.18	.35	.54	1.00	.56	.42	.40
Leisure	.04	.09	.17	.21	.30	.46	.56	1.00	.51	.52
Meds	.07	.02	.20	.26	.30	.49	.42	.51	1.00	.61
Money	.06	.01	.28	.25	.35	.40	.40	.52	.61	1.00
Transportation	.12	.03	.21	.26	.29	.36	.36	.53	.52	.64
Shopping	.06	.01	.25	.27	.27	.32	.34	.49	.52	.61
Meals	.06	.02	.24	.25	.30	.36	.32	.44	.54	.51
Laundry	.10	.05	.22	.28	.27	.35	.34	.47	.50	.52
Housekeeping	.102	.07	.21	.30	.23	.31	.31	.44	.49	.52
Home maintenance	.07	.04	.15	.18	.09	.12	.19	.18	.26	.26
Hygiene	.04	.02	.104	.18	.32	.38	.33	.37	.31	.27
Bathing	.105	.06	.106	.30	.30	.33	.28	.38	.35	.33
Feeding	.03	.05	.08	.27	.30	.26	.26	.16	.15	.15
Toilet	.04	.01	.05	.13	.26	.27	.21	.25	.17	.16
Stairs	.13	.08	.006	.26	.14	.15	.19	.27	.22	.23
Dress	.02	.002	.105	.18	.28	.33	.31	.35	.26	.25
Bowels	.01	.03	.10	.15	.20	.21	.14	.21	.15	.11
Bladder	.007	.05	.06	.15	.18	.21	.14	.21	.15	.11
Transfer	.05	.006	.049	.13	.21	.19	.20	.3	.16	.17
Ambulation	.04	.01	.06	.104	.172	.09	.12	.09	.09	.106

(table continues)

	Transp.	Shopping	Meals	Laundry	Housekeeping	Home main..	Hygiene	Bathing	Feeding	Toilet	Stairs
Age	.01	.06	.06	.105	.102	.07	.04	.105	.03	.01	.13
Chronic condition	.21	.25	.02	.05	.07	.04	.02	.06	.05	.01	.08
Informal care	.21	.25	.24	.22	.21	.15	.104	.106	.05	.05	.006
Formal care	.26	.27	.25	.22	.21	.15	.104	.106	.05	.05	.006
MMSE	.29	.27	.30	.27	.23	.18	.18	.30	.89	.13	.26
Phone	.36	.32	.36	.35	.31	.12	.38	.30	.27	.26	.14
Reading	.36	.34	.32	.34	.31	.12	.33	.28	.26	.25	.15
Leisure	.53	.49	.44	.47	.44	.19	.37	.21	.30	.25	.27
Meds	.52	.52	.54	.50	.49	.18	.31	.35	.17	.17	.22
Money	.64	.61	.51	.52	.52	.26	.27	.33	.16	.16	.23
Transportation	1.00	.67	.51	.54	.54	.26	.25	.34	.13	.132	.29
Shopping	.67	1.00	.63	.63	.61	.33	.26	.34	.12	.16	.28
Meals	.51	.63	1.00	.70	.68	.41	.24	.31	.11	.15	.26
Laundry	.54	.63	.70	.79	.39	.25	.36	.108	.15	.30	
Housekeeping	.54	.61	.68	.79	1.00	.47	.21	.33	.096	.13	.31
Home maintenanc	.33	.41	.39	.39	.47	1.00	.02	.09	.078	.02	.067
Hygiene	.25	.26	.24	.25	.21	.02	1.00	.72	.67	.68	.42
Bathing	.34	.34	.31	.36	.33	.09	.72	1.00	.51	.57	.56
Feeding	.13	.12	.11	.108	.09	.07	.67	.51	.100	.66	.31
Toilet	.13	.16	.15	.15	.13	.02	.68	.57	.66	1.00	.39
Stairs	.29	.28	.26	.30	.31	.06	.42	.56	.31	.39	1.00
Dress	.25	.24	.23	.24	.21	.002	.73	.66	.58	.68	.45
Bowels	.09	.12	.12	.109	.11	.02	.55	.47	.54	.63	.27
Bladder	.11	.13	.12	.11	.11	.046	.52	.46	.45	.54	.29
Transfer	.18	.18	.17	.17	.15	.01	.63	.56	.53	.73	.46
Ambulation	.11	.16	.13	.12	.152	.43	.41	.38	.54	.32	

(table continues)

	Dressing	Bowels	Bladder	Transfer	Ambulation
Age	.027	.019	.007	.05	.04
Chronic condition	.002	.038	.051	.006	.01
Informal care	.105	.10	.064	.04	.06
Formal care	.18	.10	.15	.13	.104
MMSE	.28	.17	.18	.21	.17
Phone	.33	.22	.21	.19	.09
Reading	.31	.16	.14	.20	.09
Leisure	.35	.21	.21	.30	.12
Meds	.26	.15	.15	.16	.09
Money	.25	.11	.11	.17	.106
Transportation	.25	.09	.11	.18	.11
Shopping	.24	.12	.13	.18	.16
Meals	.23	.12	.12	.17	.13
Laundry	.24	.10	.11	.17	.11
Housekeeping	.21	.11	.11	.15	.12
Home maintenance	.002	.02	.04	.01	.15
Hygiene	.73	.55	.52	.63	.43
Bathing	.66	.47	.46	.56	.41
Feeding	.58	.54	.45	.53	.38
Toilet	.68	.63	.54	.73	.54
Stairs	.45	.27	.29	.46	.32
Dressing	1.00	.56	.51	.64	.45
Bowels	.56	1.00	.70	.58	.42
Bladder	.51	.70	1.00	.53	.39
Transfer	.64	.58	.53	1.00	.66
Ambulation	.45	.42	.39	.66	1.00

included those items measuring functional skills, including instrumental activities of daily living and basic activities of daily living. The MSA for all 26 variables is included in Table 4.3.

Table 4.3

Evaluation of the Anti-Image Correlation

Variables	Measurement of sampling adequacy (MSA)
Age	.656
Total chronic conditions	.491*
Informal support	.918
Formal support	.945
MMSE	.932
Phone	.927
Reading	.900
Leisure	.936
Medications	.948
Money	.940
Transportation	.933
Shopping	.943
Meal management	.950
Laundering	.906
Housekeeping	.900
Home maintenance	.849
Personal hygiene	.929
Bathing	.937
Feeding	.932
Toileting	.937
Stairs	.927
Dressing	.962
Managing bowels	.896
Managing bladder	.896
Transferring	.901
Ambulation	.881

*MSA measurement of less than .50.

Extracting the Factors

The weight of the first factor encompasses the greatest degree of variance in the sample. The remaining factors must meet two criteria: They cannot be correlated with the first factor, and they express the largest amount of variance left over after the first factor is considered (Norman & Streiner, 2000). The weight of the factors was determined using the index variance of eigenvalues of 1.0. Output from the principal components analysis yielded three factors that explained 89% of the total variance. Factor 1 accounted for 55.7% of the variance, factor 2 explained 28.3%, and factor 3 represented 4.8%.

Table 4.4 shows the total variance of all three factors. Further support for the prominence of the three factors is evident in the scree plot included in Appendix E.

Table 4.4

Total Variance Explained using Principal Components Analysis

Factor	Extraction of the total	Sums of squared % of variance	Loading cumulative %
1	65.5	55.7	55.7
2	33.2	28.2	84.0
3	5.698	4.8	88.8

The three factors were then rotated using varimax orthogonal rotation. A factor matrix was produced that represents both regression weights and correlation coefficients. A valid loading matrix should show a variance that is evenly distributed across the factors. Each variable should load on only one factor, the factor loading should be close to one or zero, and the factors should be unipolar (Norman & Streiner, 2000). To identify the items or variables that had the highest loading on each factor, an eigenvalue of .40

was chosen. Although this value was somewhat arbitrarily chosen, it is the cutoff point recommended in the literature (Munro et al., 1986; Norman & Streiner, 2000).

Factor 1 showed the largest amount of variance, with a majority of the variables loading on it; here, 18 variables yielded an eigenvalue greater than 0.4. Only one variable loaded on each factor in factors 2 and 3. No variables loaded on more than one factor. All items measuring functional abilities had high loadings on factor 1, except for reading, house maintenance, and telephone. MMSE scores demonstrated a high loading on factor 2. Age loaded highly on factor 3, whereas its loading on factors 2 and 1 were low. Total chronic conditions and informal and formal caregivers did not load on any of the three factors. The results of the rotated component matrix indicates that the majority of the variables loaded on factor 1, allowing for maximum variance among the three components. Interpretation of the role of the factor is enhanced by the presence of an exclusive set of variables associated with that factor (Norman & Streiner, 2000). This is the case in this study because all three factors had an exclusive theme of variables. Factor 1 reflected functional abilities, factor 2 cognitive abilities, and factor 3 chronological age. Table 4.5 demonstrates the rotated component matrix using principal components analysis with varimax orthogonal rotation.

Factor 1 had an initial eigenvalue of 65.5, explaining 55.8% of the total variance. The variable loadings on factor 1 are listed in Table 4.6. Because all variables that loaded on this factor were measurements of the activities of daily living (ADL) and instrumental activities of daily living (IADL), factor 1 will be labeled *functional abilities*.

Table 4.5

Factor Matrix Yielded by Principal Components Analysis With Varimax Orthogonal Rotation

Items	Factor 1	Factor 2	Factor 3
Bathing	.814	.139	.073
Stairs	.766	-.027	.116
Personal hygiene	.746	.182	.012
Dressing	.741	.148	-.005
Transferring	.692	.074	.027
Toileting	.665	.140	-.015
Feeding	.562	.176	-.057
Managing bowel	.556	.098	-.004
Managing bladder	.545	.077	.016
Leisure	.545	.208	.017
Laundering	.529	.175	.082
Shopping	.523	.187	.036
Housekeeping	.518	.135	.081
Ambulation	.508	.071	.028
Transportation	.502	.202	.106
Meal management	.491	.216	.040
Money management	.472	.276	.040
Medication management	.457	.342	.050
Reading	.393	.290	.071
Telephone	.391	.365	.000
Formal caregivers	.350	.029	.121
Home maintenance	.188	.055	.066
Total chronic conditions	-.160	.157	-.072
MMSE	.192	.974	.116
Age	.032	.043	.999
Informal caregivers	.157	.100	-.038

Table 4.6

Loading for Factor 1: Functional Abilities

Item	Loading
Bathing	.81
Stairs	.77
Personal hygiene	.74
Dressing	.74
Transferring	.69
Toileting	.67
Feeding	.56
Managing bowels	.57
Managing bladder	.55
Leisure	.55
Laundry	.53
Shopping	.52
Housekeeping	.52
Ambulation	.51
Transportation	.50
Meal management	.49
Money management	.47
Medication management	.46

Factor 2 had an initial eigenvalue of 33.2 and explained 28.3% of the variance.

The MMSE score loaded as a single variable on factor 2 (.97). Because the variable loading on factor 2 is related to cognitive screening, this factor will be called *cognitive ability* (see Table 4. 7).

Factor 3 had an initial eigenvalue of 5.7 and explained 5% of the variance. The only variable loading on this factor was age (.99). This factor will be called *chronological age* (see Table 4. 8).

Table 4.7

Loading for Factor 3: Cognitive Abilities

Item	Loading
MMSE	.974

Table 4.8

Loading for Factor 3: Chronological Age

Items	Loading
Age	.999

The high loadings of variables related to functional ability support the theory that frailty is best measured by observing a decrease in the ability to carry out expected daily activities (Brown et al., 1995). Activities of daily living were the variables demonstrating the highest loadings on factor 1. Because the majority of subjects seen in the clinic were experiencing an acute change in health status, it appears that their level of independence in carrying out the basic daily tasks such as bathing and personal care may serve as a proxy variable for physical status. Bathing showed the greatest weight with a loading of .81. This variable is one of the most complex of the activities of daily living tasks because it involves multiple skills such as the ability to ambulate and transfer. Ambulation may not have loaded as highly as the other skills (.51) due to the fact that a score of independence is given if the person can walk or move 50 feet with the use of an assistive device. This implies independence only within a short distance and fails to

detect problems if the required distance is further. Ambulation of more than 100 feet is a necessity for the majority of seniors in order to cope with daily tasks such as getting to the dining room in a lodge setting. The more prevalent skill used in the clinic to determine whether an individual can be discharged home and the level of support required is the person's ability to transfer independently. The need for assistance to get out of bed or out of a chair is an indication that alternative levels of care need to be pursued. Diminished ability to carry out the practical activities of daily living can be the variables that place a person in a state of frailty. Other studies have found similar patterns of dependence when assessing a frail population. Caplan et al. (1998) found that seniors who were at high risk for admission were dependent in the following activities of daily living: bathing, dressing, and managing stairs. Brody et al. (1997) found that dependence in bathing and medication management was a strong predictor of frailty in a senior population, and Rockwell (1996) found that dependence in any ADL skills placed a person at risk of institutionalization, especially dependence in feeding and dressing. Worrall et al. (1996) used both cognitive disabilities and activities of daily living to predict the need for home care services. This study found a direct correlation between increased dependence and need for increased home care. Pressley and Patrick (1999) found similar results when reviewing data on 5,934 community dwelling seniors, in whom they found that functional decline, both in BADL and IADL, were stronger predictors of frailty than both age and number of chronic conditions. Further research is needed to prospectively explore the validity of using BADL skills as indicators for predicting frailty.

The IADL variables had lower loadings than did the BADL variables ranging between .55 to .46. The variables with the highest values were those relating to homemaking, laundry, shopping, and leisure activities. These are skills that are not normally supported in the community by formal services such as home care. Instead, these tasks normally become the responsibility of an informal caregiver. However, medication management, meal preparation, transportation, and money management may have scored lower because they can be supported in the community, thus making individuals partially independent where they otherwise would be totally dependent. The partially independent group would not appear as frail as those individuals who are totally dependent with all their care. Also, a decline in IADL skills has a less urgent affect on a person's ability to cope than a decline in BADL skills has. Thus, those people with a decline in their IADL skills would be less frail than those who experienced a decline in their BADL skills. A deterioration in IADL skills has more of an impact on the long-term considerations of where a person resides than do the immediate health risks. Geasley (1997) linked functional abilities with the level of frailty and found that the combined scores of BADL and IADL were higher in the frail group than in the nonfrail group. The skills that put a person at the greatest risk were the needs for assistance with transportation, shopping, and finances. Brody et al. (1997) found that dependence in managing medications placed a person at risk of frailty. Rockwood (1994) found that dependence in any IADL activity, especially managing finances and shopping, placed a person at risk for institutional care. The results of the factor analysis in this study support the importance of functional assessment in treating the senior population. Further research is needed to assess whether or not the key variables identified in this study

would be strong predictors of a state of frailty in another community-based senior population.

The MMSE score was the only item loading with an eigenvalue of greater than .4 on factor 2 and contributed 28% of the total variance. The MMSE is a valuable screening tool for identifying potential cognitive decline, and when used in combination with other assessments, it offers a clinician insight into possible difficulties in managing daily tasks. However, the MMSE has shown limited specificity with respect to individual clinical syndromes (Simard, 1998). The main weakness of the MMSE is that it lacks sensitivity in detecting early cognitive impairment. This is also the case in late cognitive impairment, because the MMSE does not detect decline in the late stages of cognitive impairment, especially in the patient with Alzheimer's disease (Ashford et al., 1989, Reisberg et al., 1982; Simard, 1998). Because the MMSE does not include tasks to assess executive functioning, judgement, or insight, its diagnostic usefulness is limited. However, the MMSE correlated with the ability to complete BADL and IADL tasks in this study. Thus, a change in the MMSE score can be a useful indicator of decline in cognitive ability over time and can alert the clinician to a change in the person's overall functional ability when coupled with other assessments.

Age was the only variable loading on factor 3, with a small contribution (4.8%) to explaining the total variance. Age may indirectly influence a person's ability to function, because an increase in age can lead to decreased physiological reserve, reducing a person's ability to recover quickly from stress (Buchner, 1999). Although some studies did find a correlation between age and frailty, especially in the over-80 group (Brody et al., 1997; Hogan et al., 1999) other studies did not find age to be a predictor of frailty

(McCusker et al., 1999). The reason that age was a relatively insignificant predictor of frailty in this study could be that the study population comprised a relatively homogeneous older group with an average age of 84. Because the age range was small, age was not useful in detecting large differences. In the clinical setting, chronological age is seldom useful in isolation for predicting outcomes or developing a treatment plan to reverse a condition. The heterogeneity of the senior population makes age a poor predictor for determining prognostic expectations. An assumption of similarity based on chronological age cannot be made with any age group, least of all in a senior population with multiple other variables influencing health status.

The results of the factor analysis confirm that frailty is a multidimensional state that entails the interweaving of several variables, each of which influences the overall effect of the others (Rockwood, Stolee, & McDowell, 1994). There is support for the idea that a multiple risk assessment is the best approach to developing an integrated plan that will successfully decrease the effects of frailty (Buchner, 1999). The fact that the functional abilities loaded highly on factor 1 also supports the definition by Brown et al. (1995) that describes frailty as a state which must be viewed in the context of a person's life situation. A person's inability to maintain important daily living tasks marks the individual as frail. Brown et al.'s definition is not static, and therefore particular changes to the variables may prevent decline in function. The results of the factor analysis also give direction to recognizing who is frail and the need for developing a treatment plan to reverse the frailty in order to allow the person greater quality of life. The fact that functional skills were the strongest descriptors of the frail clinic population in this study

lends support to the concept of focusing care on level of independence and monitoring changes in this level.

Discriminant Analysis

The results of the factor analysis were further subjected to examination to determine whether or not it was possible to predict levels of frailty based on discharge status. A direct discriminant analysis was completed to evaluate the predictability of the three factors. Three groups were compared, including those clients who returned home without formal services, those who needed formal support, and those who were hospitalized. The definition of frailty used in this study associated frailty with increased level of functional dependence. The degree of frailty is seen on a continuum where those subjects who are less dependent are less frail than those who are more dependent. Those clients discharged from the clinic without any home care services were considered to be the least frail because they were not in need of any home care services, whereas those who were unable to return home and were hospitalized were considered to be the most frail.

Description of the Three Groups

The three discharge dispositions used in discriminant analysis included those clients discharged home with and without formal services, and those discharged to a hospital.

Home Without Home Care Services

The mean age of those participants returning home without home care was 79, and their mean recoded MMSE score was 6.3 (standard score 24). The mean Barthel item scores of this group ranged from .74 in bathing to .16 in feeding, both scores remaining

within the minimal dependence range. The ALSAR variables ranged from a mean of .96 in meal management to a mean of .52 in leisure skills, indicating that they required minimal assistance as they scored within the independent range.

Home With Home Care Services

The mean age of the group of participants who went home with home care was 82. Their mean recoded MMSE score was 7.9 (standard score 22), and the mean Barthel item scores for this group ranged from the most dependent in mobilizing on the stairs (1.86), indicating moderate dependence, to the most independent with managing bowels (.22), indicating minimal dependence. The mean ALSAR scores of this group showed increased dependency with housekeeping (1.53) and the least dependency with leisure procurement skills (.80), indicating that they were in need of assistance in completing these tasks.

Hospitalized Group

For the group admitted to hospital, the mean age was 80, and this group had a average recoded MMSE score of 9.3 (standard score 21). The highest mean Barthel item score in the hospitalized group was dependence in the ability to climb stairs (2.51), indicating complete dependency, whereas the lowest score was the ability to feed oneself (.64), indicating minimal dependence. The greatest dependence with the mean ALSAR score was with housekeeping (1.47), and the most independent with leisure skill (.89), indicating the need for assistance to complete these tasks. The group statistics for the three discharge location are presented in Table 4.9

Table 4.9

Group Statistics

Predictors	Home, no HC Group mean	Home with HC Group mean	Hospital Group mean
Personal hygiene	.29	.60	1.13
Bathing	.57	1.27	1.66
Feeding	.16	.24	.64
Toileting	.16	.30	.85
Stairs	.89	1.86	2.51
Dressing	.30	.58	1.10
Managing bowels	.16	.22	.53
Managing bladder	.23	.35	.63
Transfers	.18	.40	.88
Ambulation	.74	.97	1.43
MMSE	6.30	7.91	9.29
Age	79.1	81.7	80.0
Leisure	.52	.80	.89
Medication management	.59	.93	.93
Money management	.76	1.15	1.11
Transportation	.87	1.31	1.24
Shopping	.93	1.40	1.39
Meal management	.96	1.35	1.40
Laundry	.96	1.41	1.39
Housekeeping	1.04	1.53	1.47

The hospitalized group appeared to be functionally more dependent for their basic care than the home-without-services group was, but they were functionally similar to the home-with-services group. The area of greatest difference among the three groups was found in the Barthel assessment measuring the basic activities of daily living, with the greatest dependence in the hospitalized group and home-with-home-care groups, in mobilizing on stairs, bathing, ambulating more than 50 feet, personal hygiene, and dressing. These two groups also had increased dependency in the instrumental activities of daily living in the areas of managing meals, finances, and housekeeping skills. There was little difference between the three groups on age and MMSE scores.

Discriminant analysis was performed using the variables from the three-factor analysis as predictors of membership in three discharge disposition groups, functional ability (factor 1), cognitive ability (factor 2), and chronological age (factor 3). Of the original 2,505 cases, 1,012 were used. Cases were eliminated due to a combination of out-of-range group codes or missing variables. With all three factors combined, the total number of subjects at home without home care was 360, at home with home care was 537, and in the hospital was 115.

The missing data were scattered over predictors and groups in a random fashion so that deletion of those missing variable cases appeared to be appropriate. The groups were unequal in size, with the largest representation of subjects in the community groups. There is an advantage in having the largest representation being community-dwelling seniors because this is the group that would receive the most benefit from early identification of frailty, preventing the moderately frail from progressing to severely frail. It is not surprising that the largest number of patients returned home from the clinic

because the mandate of the clinic was to coordinate the most appropriate services so that the person could be maintained at home.

A histogram of the three factors was completed to identify whether or not there were normal distributions. Functional ability and cognitive ability were slightly skewed to the right, whereas chronological age appeared to have a normal distribution (see Appendix F). Although two factors suggest right-sided skewing, the sample sizes would seem large enough to suggest normalcy of the sampling distribution of means (Munro et al., 1986). Therefore there is no reason to expect distortion of results due to nonnormal distributions. The data were also tested for homogeneity of variance. With a sample size that is large but not equal, Tabachnick and Fidell (1996) suggested that if the probability resulting from the test for homogeneity of variance is greater than .001, it is safe to proceed with the analysis of the data. Because the probability was $>.000$, the analysis was continued.

Summary of Direct Discriminant Function

Direct discriminant analysis was carried out looking at discharge status in the three dimensions. The first function explained 77% of the variance with a canonical correlation of .426, a Wilks' Lambda of .769, a chi square of 262, and a $p \geq .000$, indicating that the first function showed a strong ability to separate into the groups. The second function explained 22% of the variance and yielded a canonical correlation of .244. The Wilks' Lambda increased to .940, the chi square dropped to 61.5, and the p remained at $\geq .000$. The second function did show an ability to separate the groups, but nevertheless did so at a reduced level. Because the Wilk's Lambda test indicates the association between the independent and the dependent variables, an increase in the

Wilk's Lambda score here from .769 to .940 confirms that the variables remaining after function 1 have less effect on predicting group membership. The summary of the canonical discriminant functions is shown in Table 4.10.

Table 4.10

Summary of Canonical Discriminant Functions

Function	Eigen-value	% variance	Canonical correlation	Wilks' Lambda	Chi-squared	df	Sig.
1	.222	77.8	.426	.769	261.994	40	.000
2	.063	22.2	.244	.940	61.5	19	.000

Standardized discriminant function coefficients are predicted from the sum of the series of standardized predictors, indicating the relative importance of the independent variable. Tabachnick and Fidell (1996) suggested that a correlation of .30 may be considered eligible values for a loading. In function 1 the highest correlations were bathing, with a loading of .421; stairs, with a loading of .460; and housekeeping skills, with a loading of .339. In function 2 bathing had a high loading on toileting, with a loading of .482; and age, with a loading of .367. In calculating the pooled within-group correlations between predictors and standardized discriminant functions, the largest absolute correlation for function 1 included stairs, bathing, housekeeping skills, shopping skills, laundering skills, transportation skill, meal and medication management, leisure skills, and MMSE score. The best predictor of functions 1 was the ability to manage stairs, with a loading of .75. Those clients who went home and had home care had more difficulty managing the stairs (mean=1.7) than the home-without-home-care group

(mean=.90), but had less difficulty than the hospital group (mean=2.5). The need for assistance with bathing also showed a high loading of .72. The ability to bathe distinguished between the groups, with those with home care (mean=1.3) demonstrating increased difficulty compared to those home without home care (mean=.58) and less difficulty than the hospital group (mean=1.1). The coefficients for all the variables in function 1 are charted in Table 4.11.

Table 4.11

Pooled Within-Group Correlation and Group Means Among Variables With the Largest Absolute Correlation for Function 1

Predictor	Loading	Home Group mean	Home with sup Group mean	Hospital Group mean
Stairs	.754	.897	1.867	2.51
Bath	.722	.577	1.275	1.669
Housekeeping	.594	1.04	1.53	1.47
Shopping	.583	.9306	1.40	1.39
Laundering	.512	.9611	1.41	1.39
Transportation	.496	.872	1.31	1.24
Meal management	.495	.961	1.37	1.40
Finances	.444	.761	1.15	1.11
Medications management	.394	.5944	.9367	.9391
Leisure	.385	.525	.808	.895
MMSE	.355	6.30	7.91	9.29

Those loading on the second function included toileting, feeding, transferring, dressing, ambulation, personal hygiene, bowel maintenance, age, and bladder maintenance. The highest correlations in function 2 were the ability to toilet oneself (.69) and the ability to feed oneself (.59). The group mean for toileting in the home-without-assistance group was .17, in the home-with-assistance group was .31, and in the hospital group was .85. The group mean for ability to feed oneself in the home-without-services group was .17, in the home-with-services it was .24, and in the hospital group it was .65. The coefficients for the variables for function 2 are in Table 4.12.

Table 4.12

Pooled Within-Group Correlations and Group Means Among Variables With the Largest Absolute Correlation for Function 2

Predictors	Loading	Home Group mean	Home with sup Group mean	Hospital Group mean
Toileting	.690	.1667	.3073	1.1304
Feeding	.594	.1667	.2402	.6435
Transferring	.551	.1889	.4097	.8870
Dressing	.509	.3028	.5847	1.1043
Ambulation	.504	.7472	.9777	1.4348
Personal hygiene	.496	.2972	.6034	1.1304
Managing bowels	.449	.1639	.2253	.5391
Age	-.361	79	82	80
Managing bladder	.315	.2333	.3520	.6348

Group centroids, the average discriminant scores for each group, were calculated to determine the ability of each function to distinguish between categories reflected in the group. A function plot was drawn to reveal how groups are positioned along the two discriminant functions. In this graph the discriminant functions are on the axis, and the group centroids are plotted along the axis. The discriminant function plot is attached in Appendix G.

Function 1 demonstrates a centroid reading of -.62 in the home-without-support group, .59 in the hospital group, and .29 in the home-with-support group. In the second function the group centroids were .066 for the home-without-support group, the hospital group had a reading of .63, and the home-with-support group had a score of -.18. In observing the details of the graph in the first discriminant function, the home-without-support group is separated from the home-with-support and the hospital group, indicating that this function was able to separate the home-without-support group from the other two groups. The second function had similar results, indicating that the home-with-support group and the hospital group are not as easily separated.

The classification tables compare the actual with the predicted group membership. The purpose of classification is to assess the predictive value of the discriminant functions and the consistency of the data (Tabachnick & Fidell, 1996). A prior probability was calculated to determine the percentage of subjects in each group that may be correctly classified by chance alone. The prior probabilities were calculated from a total number of 1012 cases. The prior probability for the group without home care services ($n=360$) was .356 or 128 cases, while for the group with support ($n= 537$) was .531 or 285 cases and for the hospital group ($n= 115$) was .114 or 13 cases. The total

number of cases that could be classified by chance alone was 426 or 41%. It is necessary for the classification results to be higher than the prior probability to ensure adequate predictability of the discriminant functions

In the classification results, the predicted group membership showed the home-without-home-care group was comprised of 205 cases (56.9%) that were correctly classified, whereas 146 (40.6%) were incorrectly classified into the home-with-home-care group and 9 (2.5%) into the hospital group. For the home-with-home-care group, 406 (75.6%) were correctly classified, whereas 110 (20.5%) were incorrectly grouped into the home-without-home-care group, and 21 (3.9%) were classified into the hospital group. In the hospital group, only 14 (12.2%) were correctly classified, with 80 (69.9%) grouped in the home-with-home-care group and 21 (18.3%) in the home-without-home-care group. This indicates that those in the home-with-home-care group representing those clients who were classified as being moderately frail were more likely to be correctly classified (75%) than those in either the home-without-home-care group (56.6%) or the hospital group (12.2%). The latter group tended to be the least reliable in terms of predictability of classification. The results indicate that 61.8% of the grouped cases were correctly classified, which appears to be a low predictive value. A summary of the prior probabilities and classification results is demonstrated in Table 4.13.

Table 4.13

Classification Results and Prior Probabilities for the Three Groups

Discharge status	Predicted Home without HC N=360	Group Home with HC N=537	Membership Hospital N=115
Home without HC	56.9%	40.9%	2.5%
Home with HC	20.5%	75.6%	3.9%
Hospital	18.3%	69.6%	12.2%
Prior Probabilities	360/1012 = .356	537/1012 = .531	115/1012 = .114

Bold typing indicates those cases correctly classified.

61.8% of original grouped cases correctly classified.

Predicting Discharge Status

The results indicate that the measurement of function, cognition, and increased age in combination were better predictors of who could go home with home care support than those who did not need home care support or those needing hospitalization.

Hospitalized Group

The hospital group had the poorest prediction rate, at 12.2%. The poor predictive value of the hospital group may be explained by the fact that the number of chronic conditions was tracked, rather than the effect of the disease on health status. The instability of a medical condition is a criterion that normally determines the need for an admission to an acute care institution. For example, it is extremely difficult to justify an admission to a tertiary care institution for a functional decline in ability such as falls if a medical reason for this cannot be identified. An exception would be if there was evidence of an unstable condition as a result of the fall. Because it is well documented that disease processes usually proceed frailty (Geasley, 1997), disease impact on health status needs

to be evaluated. Brown et al. (1995) suggested that the continuum of frailty is influenced by a person's reserve capacity. A decrease in reserve capacity and an increase in the amount of stress moves a person along the frailty continuum. McCusker et al. (1999) found that a functional loss of only 10% was indicative of a significant marker for physical frailty. These individuals comprising the two groups of hospital and home-with-home-care services may be very similar in their amount of reserve to cope with the stress. This is indicative of the fact that 69.9% of those in the hospital group were classified into the home-with-services group. A reflection of the correlation of frailty and disease may be evident in the functional status of the person prior to the onset of disease compared with his/her functional abilities post disease (Carlson et al., 1998). Gill et al. (1999) found that impairments in physical performance and cognitive status were two of the main determinants of preclinical disabilities. The results of their study indicated that the magnitude of an event cannot be identified by diagnosis alone, because older persons are susceptible to multiple complications that will affect their health outcome. Functional disability was a flag for the need to assess for further explanation of the decline. This usually resulted in the identification of an unstable medical condition.

The assessment of the subject's baseline vulnerability was not available in the database for evaluation. Therefore change in status could not be assessed. Because a hospital stay can also have an iatrogenic effect on a senior, clinic staff make every attempt to support the person in the community. This may have also increased the similarity between the two groups because without the team support, hospitalization may have been inevitable. It is evident that those moving from moderate to severe frailty are a vulnerable group who may require only a slight change. The assessment tools used in the

clinic may not be sensitive enough to detect small changes and therefore may not identify the difference between these groups. The key difference that may increase predictability would be the measurement of the decline in function over a short period of time. A prospective study looking at changes in functional and medical status might well have better predictive value.

Home With Home Care Services Group

The mandate of the clinic was to assess health and functional status and implement early intervention to prevent clients from experiencing further declines and requirements for hospitalization. The clinic team coordinated services in the home in order to offset a functional decline. It is understandable, therefore, that the home-with-home-care group was the largest in size and had the best prediction rate, at 75.6%. Caplan et al. (1998) found that the type of functional loss experienced predicts discharge disposition. Dependency in bathing, dressing, and other more complex IADL skills is suggestive of the sort of frailty that would best be managed in a home environment. Dependence in the management of bowel or bladder routines is suggestive of the need for nursing home admission. Results from the discriminant analysis were consistent with Caplan's findings because the main predictors for function 1 were bathing, managing the stairs, completing housekeeping duties, procuring transportation, and managing meals and medications.

Rosswurm and Lanham (1998) studied the characteristics of seniors discharged from hospital and found that the more dependent the patient in managing ADLs, the greater the risk of hospitalization within 30 days post discharge. A relationship was also found between the number of health problems and the likelihood of receiving formal

home support. There was a 41% chance of receiving services if a person had three problems and 64% of receiving services with six problems. Tierney and Worth (1995) found an increased rate of readmission within two weeks of discharge related to a continued decline in the original problem. This moderately frail group may benefit from close follow-up and an increase in community services to ensure improvement and the avoidance of further intervention such as hospitalization. The home-with-home-care services and the hospitalized groups may be subsets of the most frail in that if community services were not available, these patients would all need hospitalization. The predictors that were the most prevalent for function 1 had all been previously defined in the literature as valid markers of frailty. The missing component was the measurement of change. McCusker et al. (1999) established a questionnaire that determines the person's ability to perform a task prior to and after the illness. This may need to be incorporated into clinic assessment tools. A prospective study examining the health status of this group in two and four weeks to determine whether they were still at home, whether they required a further increase in services, or whether they had a reduction in services would be of value to determine the speed and reason for a decline in function.

Home Without Home Care Services Group

The home-without-home-care-services group showed higher independence on all predictors in function 1, and therefore members of this group appeared to be the least frail of the three groups. Here, results showed a 56.6% prediction rate for group membership. This group may be similar to the home-with-home-care-services group, with the greatest difference between the two being the availability of an informal caregiver. Because formal and informal support did not load on any of the three factors, it was not used in

the discriminant analysis. Formal home care services are rarely offered when a caregiver is available. Therefore, it is questionable how much support provided by an informal caregiver would have to be provided by home care in the event that the caregiver was not available. The home-without-home-care-services group was at high risk of experiencing an undetected decline in function as individuals in this group did not have an immediate link to any of the professional services. Although these seniors were higher functioning than those in the other two groups, they came to the clinic because of a health concern. Thus, monitoring of this group would also be of benefit. A prospective study looking at the functional change that brought these individuals to the clinic would give valuable insight into the needs of the mildly frail population and hopefully assist in determining how to assist this group maintain a high level of function.

Limitation of the Study

The following limitations should be considered when interpreting the findings. The study was a secondary analysis of a clinic database and therefore was not designed to answer a specific set of research questions. The researcher was closely involved in establishing the database and choosing the appropriate assessment tools, but did not have control of data entry. The clinic was established to offer a prompt intervention that would address acute issues in a timely manner. The main purpose was to triage and coordinate the most appropriate services to support continued community residence for the clinic population. Follow-up was limited to only those patients who required it in the view of the clinician. The assessment measurement was completed once and therefore could not be assumed to endure over time. Hospitalization was seen as an endpoint, and no further follow-up was organized. This lack of follow-up limits the amount of change that can be

measured. Use of a dynamic model of frailty is crucial to assess whether or not a person is moving along the continuum of frailty and to evaluate which interventions have decreased such a progression. A single, one-time assessment and evaluation of this frail group may not be an effective measurement of their capabilities or progress. Repeated follow-ups over a longer period of time may be necessary for more accurate measurements and prediction. The mandate of the clinic was to support seniors in the community, and therefore the greatest number of discharges would be to home with home care. The uneven distribution of the cases in the three groups may have also affected the predictability of the factors. A more even distribution of cases, especially in the hospitalization group, might allow for more accurate prediction.

Components that might have been influential in evaluating the progress of frailty, such as measurement of disease status, reason for not completing the MMSE, depression score, and health status of informal caregiver were not available for analysis. Although these components may not have directly affected discharge status, they may have had an indirect influence on ability to cope. The gold standard for the diagnosis of frailty throughout the literature was that of a geriatrician. The assessments were completed by a multidisciplinary team with expertise in care of the elderly, and a geriatrician was seldom involved. However, it is unlikely that the discharge outcomes would have changed with the involvement of a geriatrician. The study population accessing the seniors' clinic is considered to be frail, and the degree of frailty may well have been too small to measure using standard assessment tools.

Strength of Study

The availability of a large database reflecting health-status variables pertaining to frail senior population residing in the community allowed for the evaluation of the most prevalent predictors of frailty. The descriptors of frailty defined in the literature were prevalent in this study population and indicated that the functional component of an assessment is relevant to frail seniors when calculating approximate vulnerability and the need for health care services. The high loadings of functional abilities as predictors of frailty support the basic principles of geriatric medicine; namely, the need for functional descriptors when assessing the elderly population. Also the strength of the functional assessment, enhanced by other indicators of frailty in this study, further supported the need for using a multidisciplinary team approach in the care of the elderly.

The measurement of frailty would be helpful in monitoring the health status of vulnerable seniors. This study explored the components of frailty. It further developed a theoretical definition of frailty, specified variables derived from the theoretical definition, and identified observable indicators. The next step would be to establish an evaluative measurement of frailty using the three factors of functional ability, cognitive ability, and chronological age. The components identified by the factor analysis need to be tested prospectively and psychometric measurement appointed for the different degrees of frailty.

CHAPTER FIVE

CONCLUSION

Through factor analysis, the number of variables used to assess a frail population was reduced to those that were the most efficient markers of frailty. The results of the analysis indicating high loadings on functional abilities, cognitive abilities, and chronological age supported these variables that were commonly identified in the literature. The many items comprising the factors support Brown et al.'s (1995) contention that frailty cannot be defined within a single clinical parameter. The impact of frailty is multifactorial, and therefore this concept must be measured across a number of areas. The three factors identified had the strongest predictability when determining the discharge disposition of returning home with home care services versus returning home without home care services or being hospitalized.

Implications of the Findings

Defining the Concept of Frailty

Seniors define their quality of life in terms of their ability to work and perform their usual roles in their life (Beidler & Bourbonniere, 1999). This concept of health is equated to their sense of worth and measured by the level of independence that they are able to maintain throughout their daily lives. Brown et al. (1995) further expanded on this functional definition of health by labeling a state of dependency as frailty. In Brown et al.'s definition, frailty occurs once a person is no longer able to complete a task associated with an activity of daily living important to them. The indicators of frailty defined in this study supported the link between frailty and functional abilities. The factors with the highest weight included those items measuring an individual's ability to

perform the basic activities of daily living such as bathing, managing stairs, completing personal hygiene, dressing, transferring, and ambulating. The factors used to predict group membership in terms of those who were mildly frail, moderately frail, and severely frail was the ability to manage stairs and to bathe. This study was able to describe frailty in terms that were both measurable and easily understood. Assessment of an individual's ability to bathe or manage stairs is not part of a routine health examination. The normal examination focuses mainly on disease symptoms. Definitions of health used by health professionals must begin to incorporate the concept of function alongside the identification of disease morbidity and mortality. The results of this study support extensive literature that used indicators of function to define the concept of frailty.

This study population suggests that the concept of frailty is dynamic and that a person can move along a continuum of frailty. Adopting a dynamic definition of frailty invites health care professionals to look for a change that can enhance health and maintain functional status. The different levels of frailty identified in this study encourage the evaluation of the progress of individuals in these three groups over an extended period of time. Closer follow up with individuals at each level of frailty would further test the relationship between disease process and functional and cognitive changes.

Specific Needs of Frail Seniors

Data from the factor analysis showed a correlation among the variables associated with the measurement of the basic activities of daily living, the instrumental activities of daily living, and the individual's cognitive ability, indicating the impact that failure in one area has on the other. For example, decreased ability to ambulate affects a person's

ability to bathe and prepare meals. With the use of functional descriptors the unique qualities of individuals at each level of frailty can be examined to ensure that appropriate care is implemented. The key need of the mildly frail subgroup is prevention of further decline. Markers of frailty can be utilized in health promotion or wellness programs. With the knowledge that bathing and managing stairs were strong indicators of frailty, seniors' health-promotion programs could focus on preserving physiological capacities by including specific activities such as strength and balance exercises versus the traditional approach of disease-management strategies such as heart-disease screening. Programs need to target interventions that support a person's ability to remain independent. Prevention strategies could include introducing safe methods to complete daily tasks such as bathing, or teaching processes of conserving energy to complete tasks such as cooking and housekeeping. Ongoing health-promotion programs rather than isolated, quick interventions may have more success in maintaining health status in frail seniors.

In this study there were similarities between the moderately frail group and the most frail group, as evidenced by the group means of the functional predictors and the difficulty in predicting group membership between these two. These similarities underscore the importance of close monitoring to ensure that a timely intervention is in place. Those in the group classified as moderately frail have the potential to improve with adequate intervention, but they also could continue to deteriorate with inadequate intervention. Brown et al. (1995) emphasized the importance of an intervention that increases the individual's reserve capacity or at least modifies stress to reverse decline in

functional abilities. Further research is needed to determine how to accurately measure this decline to help plan successful interventions and decrease the risk of further decline.

The decreased ability of the indicators to distinguish clearly between the severely and moderately frail is important because it accentuates the lack of clear descriptors that identify the degree of difference between the groups. The importance of the impact of a disease process on one's health status cannot be eliminated from the assessment. Further research is warranted to test whether a health-status measurement clarifies the difference between the two groups. The decreased ability of the indicators to successfully describe all three levels of frailty emphasizes the complexity of the concept and the overlap between the three levels. Describing frailty on a continuum is based on the assumption that there will be overlap at the high and low ends of each group, thus making clear distinctions between the parts of the group difficult to measure. Standard tools used in the usual geriatric assessment may not be capable of measuring the difference between the levels of frailty. Using the predominant indicators identified in this study may lead to the development and adaptation of tools that are sensitive to small changes and more effective in identifying key differences.

Health Care Delivery

The difficulty of correctly predicting group membership among the most vulnerable of the senior's population, the moderate and severely frail, highlights the need for accurate follow up for these seniors. A recognized limitation of this study was the lack of follow up. Due to the complexity of these individuals' health care requirements, a single assessment may not be adequate to ensure that reversibility of the concern that precipitated the decline in health was identified. This was evident with the low

predication rate of 12% accuracy for the hospitalized group, with the majority of those not correctly classified falling in the home-with-home-care group. Establishing means of safely monitoring a person in the community may be more beneficial than hospitalizing every frail senior who presents as being at risk. A hospital setting is not conducive to satisfying the needs of the senior and may in the end precipitate more problems. The realization that the community senior is comparable to those in hospital requires that the delivery of community care be reevaluated. In the present system hands-on care is administered by health care providers with minimal training. The need for skilled professionals directly involved with the care of an individual is essential. An advanced practice nurse (APN) directly involved in the management of the individual's care is justified to monitor the progress of these high-risk seniors.

In the absence of a sufficient number of trained health care professionals providing hands-on-care to seniors, there is a need for a reasonably simple tool capable of measuring small changes in a frail population. This tool could be used to ensure that a health professional is notified early of any change in a senior's overall status. The indicators of frailty that were predominant in this study were simple measurements that nonprofessionals would feel comfortable using. Screening functional and cognitive abilities can alert clinicians to provide imperative interventions as the need arises. With close follow up and appropriate interventions by the APN, a crisis approach to accessing the health care system may be alleviated.

A team approach to care has been the gold standard for geriatric assessment. However, with an aging population the involvement of a geriatric assessment team in the care of all aging seniors is neither feasible nor cost effective. The need for screening and

making appropriate referrals to these teams is essential in order for maximum utilization of available expertise. With the use of the indicators identified in this study, the relevance of a few markers could indicate the appropriateness and urgency of the referrals. The use of predictors of frailty will eliminate some of the complexity of the assessment and allow for the establishment of a common understanding between all professionals regardless of their expertise or interest. This common knowledge could foster a stronger partnership between geriatric professionals and other care providers such as those delivering home care services and family physicians.

An individual's level of frailty could also be used as a guide for the type of community service provided. Further research looking prospectively at the needs of these groups will assist in establishing clinical guidelines outlining the amount and type of professional involvement necessary for follow up and the timeliness of the intervention. Involvement of the APN, a new role within the present health care system, may be the missing link that would provide an adequate safety net for the vulnerable senior. For example, those individuals who are moderately frail may be best followed by a team of professionals such as an APN partnered with a physician with geriatric expertise, allowing for adequate access to medical intervention. Those who are severely frail may best be directly connected to the physician with geriatric expertise or a geriatrician, who could then liaise with the APN. The mildly frail group could be managed in the community by health care professionals with increased understanding of the needs of this vulnerable group. They in turn could link with the APN whenever the individual experienced an acute change. The involvement of the primary health care provider at all levels of care is essential to ensure continuing positive impacts.

The data from this study describe the comprehensive level of care that the community is expected to provide to support frail elderly people. Although informal and formal caregiving was not a strong predictor of frailty in this study, the effect of this support cannot be undermined. Acknowledgement of the complexity of problems relative to frailty facing community-based seniors is information that must be continually shared with policy makers to ensure that adequate fiscal resources are allocated to maintain an acceptable standard of care. Tracking frailty with indicators that personnel at all levels can use and understand clarifies the individual's direct need. Describing the needs of a senior in terms of daily needs such as bathing and meal management provides a realistic description of the type of resources necessary to continue living at home.

The undetected or silent partners who also support these frail seniors are the informal caregivers such as family and friends. This study analyzed the number of caregivers involved in the person's care, and the results did not indicate a strong indicator for frailty. The amount of caregiving may not have a direct influence on the individual's frail state but does have a large impact on the support of the frailty. More qualitative measurements of caregiving may be necessary to accurately evaluate the effect of caregiver support and level of frailty.

Summary

The purpose of this study was to explore and describe the key predictors of frailty, and the results warrant further research to develop a tool that will allow for the measurement of change, assess the use of these markers for program development, and establish clinical guidelines for follow-up care. Thus, this study was successful in identifying predictive and measurable indicators of frailty. The increased influence of

functional predictors as measurements of frailty supports the need to incorporate these items in all health assessments for seniors. The need for further evaluation and testing to formulate a grading system that will effectively allow for the continued monitoring of this frail population is indicated. The difficulty in distinguishing between the most complex frail groups and those who are less frail alerts clinicians to the need to implement appropriate safety nets to allow for timely interventions. Further research comparing these levels of frailty is necessary to guide clinical practice. The results of this study have laid the groundwork for further research and have given new insight into the concept of frailty.

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APPENDIX A
MINI MENTAL STATE EXAMINATION

Mini-Mental State Examination (MMSE)

Maximum Score	Score	
		ORIENTATION
5	_____	What is the (year) (season) (date) (day) (month)?
5	_____	Where are we: (province) (country) (town or city) (hospital) (floor)?
		REGISTRATION
3	_____	Name 3 common objects (e.g., "apple," "table," "penny"). Take 1 second to say each. Then ask the patient to repeat all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Make a maximum of 6 trials. Count trials and record. Trials: _____
		ATTENTION AND CALCULATION
5	_____	Spell "world" backwards. The score is the number of letters in correct order (D_L_R_O_W_). [Note: Instead of "world", the following may be used — subtract 7 from 100 and keep subtracting 7 from the result until you tell him/her to stop.]
		RECALL
3	_____	Ask for the 3 objects repeated above. Give 1 point for each correct answer. [Note: Recall cannot be tested if all 3 objects were not remembered during registration.]
		LANGUAGE
2	_____	Name a "pencil," and a "watch." (2 points)
1	_____	Repeat the following: "No ifs, ands, or buts." (1 point)
3	_____	Follow a 3-stage command: "Take a paper in your right hand, fold it in half, and put it on the floor." (3 points)
		READ AND OBEY THE FOLLOWING:
1	_____	Close your eyes. (1 point)
1	_____	Write a sentence. (1 point)
1	_____	Copy the following design. (1 point)
		No construction problem
Total Score	_____	

Adapted from Folstein MF, Folstein SE, McHugh PR, "Mini-Mental State": A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;12:196-8, and Cockroft J R, Folstein MF, Mini-Mental State Examination (MMSE). *Psychogeriatrics* 1988;24;4, 689-92

APPENDIX B

ASSESSMENT OF LIVING SKILLS AND RESOURCES SCALE

Assessment of Living Skills and Resources Scale

ALSAR TASKS	SKILLS	SCORE	RESOURCES	COMMENTS
Telephoning	Locates phone nos., dials, & receives info.	0	0	
		1	1	
		2	2	
Reading	Reads and uses written info.	0	0	
		1	1	
		2	2	
Leisure	Plans & performs satisfying leisure activities	0	0	
		1	1	
		2	2	
Medication Management	Procures & takes medication as ordered	0	0	
		1	1	
		2	2	
Money Management	Manages own money or procures financial services	0	0	
		1	1	
		2	2	
Transportation	Walks, drives or procures rides	0	0	
		1	1	
		2	2	
Shopping	Lists, selects, buys, orders, stores goods	0	0	
		1	1	
		2	2	
Meal Preparation	Performs all aspects of meal preparation or procures meals	0	0	
		1	1	
		2	2	
Laundering	Performs or procures all aspects of doing laundry	0	0	
		1	1	
		2	2	
Housekeeping	Cleans own living space or procures housekeeping services	0	0	
		1	1	
		2	2	
Home Maintenance	Performs or procures home maintenance	0	0	
		1	1	
		2	2	

Skills: 0 = independent 1 = partially independent 2 = dependent

(individual accomplishes or procures task)

Resources: 0 = consistently available 1 = inconsistently available 2 = not available or in use

APPENDIX C
BARTHEL ACTIVITIES OF DAILY LIVING SCALE

Time Frame	Score (circle)
1. Personal hygiene <ul style="list-style-type: none"> a) pt is unable to attend to personal hygiene, and is dependent in all aspects b) assistance is required in one or more steps of personal hygiene c) some assistance is required in one or more steps of personal hygiene d) pt is able to conduct his/her own personal hygiene, but requires minimal assistance and or the operation e) pt can wash his/her hands & face, comb hair, clean teeth & shave. (A male patient may use any kind of razor but must insert the blade or plug in the razor without help, as well as retrieve it from the drawer or cabinet. A female pt must apply her own make-up, if used, but need not braid or style her hair) 	a = 0 b = 1 c = 3 d = 4 e = 5
2. Bathing Self <ul style="list-style-type: none"> a) total dependence in bathing self b) assistance is required in all aspects of bathing c) assistance is required with either transfer to shower/bath or with washing or drying; including inability to complete a task because of condition or disease, etc. d) supervision is required for safety in adjusting the water temp. or in transfer e) pt may use a bathtub, shower or take a complete sponge bath. Pt must be able to do all the steps of whichever method is employed without another person being present 	a = 0 b = 1 c = 3 d = 4 e = 5
3. Feeding <ul style="list-style-type: none"> a) dependent in all aspects and needs to be fed b) can manipulate an eating device, usually a spoon, but someone must provide active assistance during the meal c) able to feed self with supervision. Assistance is required with associated tasks such as putting milk/sugar into tea, salt, pepper, spreading butter, turning a plate or toher "set up" activities d) independence in feeding with prepared tray except maybe cut meat, open milk carton, jar lid, etc. Presence of another person is not required e) pt can feed self from a tray or table when someone puts the food within reach. Pt must put on an assistive device if needed, cut the food, and if desired, use salt and pepper, spread butter, etc. 	a = 0 b = 2 c = 5 d = 8 e = 10
4. On & Off toilet <ul style="list-style-type: none"> a) fully dependent in toileting b) assistance required in all aspects of toileting c) assistance may be required with management of clothing, transferring or washing hands d) supervision may be required for safety with normal toilet. A commode may be used at night but assistance is required for emptying and cleaning e) pt is able to get on and off toilet, fasten and unfasten clothes, prevent soiling of clothes and use toilet paper without help. If necessary, the pt may use a bedpan or commode, or urinal at night, but must be able to empty it and clean it 	a = 0 b = 2 c = 5 d = 8 e = 10
5. Stairs - one flight <ul style="list-style-type: none"> a) pt is unable to climb stairs b) assistance is required in all aspects of stair climbing, including assistance with walking aids c) pt is able to ascend/descend but is unable to carry walking aids, and needs supervision and assistance d) generally no assistance is required. At times supervision is required for safety due to morning stiffness, SIB e) pt is able to go up and down a flight of stairs safely without help or supervision. Pt is able to use handrails, cane or crutches when needed and is able to carry these devices as he/she ascends or descends 	a = 0 b = 2 c = 5 d = 8 e = 10
5. (a) Stairs - more than one flight of stairs	

6. Dressing

a) pt is dependent in all aspects of dressing and is unable to participate in the activity
 b) pt is able to participate to some degree, but is dependent in all aspects of dressing
 c) assistance is needed in putting on, and/or removing any clothing
 d) only minimal assistance is required with fastening clothing, such as buttons, zips, bra, shoes, etc.
 e) pt is able to put on, remove and fasten clothing, tie shoelaces, or put on, fasten, remove corset, braces as prescribed

a = 0
 b = 2
 c = 5
 d = 8
 e = 10

7. Bowels

a) pt is bowel incontinent
 b) pt needs help to assume appropriate position, and with bowel movement facilitatory techniques
 c) pt can assume appropriate position, but cannot use facilitatory techniques, or clean self without assistance and has frequent accidents. Assistance is required with incontinence aids such as pads, etc.
 d) pt may require supervision with the use of suppository or enema and has occasional accidents
 e) pt can control bowels and has no accidents, can use suppository, or take an enema when necessary

a = 0
 b = 2
 c = 5
 d = 8
 e = 10

8. Bladder

a) pt is dependent in bladder management, is incontinent or has indwelling catheter
 b) pt is incontinent but is able to assist with the application of an internal or external device
 c) pt is generally dry by day, but not by night, and needs some assistance with devices
 d) pt is generally dry by day and night, but may have an occasional accident or need minimal assistance with devices
 e) pt is able to control bladder day and night and/or is independent with internal or external devices

a = 0
 b = 2
 c = 5
 d = 8
 e = 10

9. Chair/bed transfer

a) unable to participate in transfer. Two attendants required to transfer pt with or without a mechanical device
 b) able to participate but maximum assistance of one other person is required in any aspect of the transfer
 c) transfer requires the assistance of one other person. Assistance may be required in any aspect of the transfer
 d) the presence of another person is required either as a confidence measure or to provide supervision for safety
 e) pt can safely approach the bed in a wheelchair, lock the brakes, lift the footrests, move safely to the bed, lie down, come to a sitting position on the side of the bed, change the position of the wheelchair and transfer back into it safely. Pt must be independent in all phases of this activity

a = 0
 b = 3
 c = 8
 d = 12
 e = 15

10. Ambulation

a) dependent in ambulation
 b) constant presence of one or more assistants is required during ambulation
 c) assistance is required with reaching aids and/or their manipulation. One person is required to offer assistance
 d) pt is independent in ambulation but unable to walk 50 metres without help or supervision is needed for confidence or safety in hazardous situation
 e) pt must be able to wear braces if required, lock and unlock these braces, assume standing position, sit down and place the necessary aids into position for use. Pt must be able to use crutches, canes, or a walkarette and walk 50 metres without help or supervision

a = 0
 b = 3
 c = 8
 d = 12
 e = 15

11. Wheelchair management (alternative to ambulation) - only use if pt scored a "1" on ambulation

a) dependent in wheelchair ambulation
 b) pt can propel self short distances on flat surface, but assistance is required for all other steps of wheelchair management
 c) presence of one person is necessary and constant assistance is required to manipulate chair to table, bed, etc.
 d) pt can propel self for a reasonable duration over regularly encountered terrain. Minimum assistance may still be required in "tight corners"
 e) to propel wheelchair independently, pt must be able to go around corners, turn around, manoeuvre the chair to a table, bed, toilet, etc. Pt must be able to push a chair at least 50 metres

a = 0
 b = 3
 c = 8
 d = 12
 e = 15

APPENDIX D
LETTERS OF PERMISSION



Memorandum

April 24, 2000

TO: Teresa Genge, Clinical Supervisor – Seniors Clinic

cc: file

FROM: Laurel Becker, Patient Care Manager – Medicine

RE: Thesis

In support of your thesis, you may use charts of the Seniors Clinics for data. As we discussed, I understand that no patient names will be used and charts will be reviewed on the premises of the University of Alberta Hospital.

The best of luck for your endeavour – we are looking forward to reading your thesis.

If you require any further information, please call me at 407-3423.

A handwritten signature in black ink, appearing to read "Laurel B." followed by a short horizontal line.

Laurel Becker
Patient Care Manager
Medicine



Mailing Address: 31 St. James Avenue, Suite 1
 Boston, Massachusetts 02116
 (617)587-4215 (617)587-4201 Fax
www.minimental.com

June 19, 2000

Teresa Genge
 Faculty of Nursing
 University of Alberta

Fax: (780) 407-2006

Dear Ms. Genge:

Re: University of Alberta Faculty of Nursing ("the Licensee") requests permission to use the MMSE for use in a Masters Thesis Project measuring frailty in the senior community population ("the Proposed Use").

Thank you for your interest in the Mini Mental State Exam (MMSE). "The copyright in the Mini Mental State Examination is wholly owned by the MiniMental LLC, a Massachusetts limited liability company."

We are now offering an annotated version and would be pleased to grant you permission to reproduce copies of the Annotated Mini Mental State Exam (AMMSE) (*Exhibit A*) to be used as an educational vehicle. *Permission is being granted for use of the AMMSE in a Masters Thesis Project measuring frailty in the senior community population. Researchers must be advised that for clinical use of the MMSE, permission must be obtained from Mini Mental LLC.* If you are interested in using the Mini Mental State Exam, the administrative fee for issuance of the license granting permission to use the MMSE is \$85.00 (eighty-five US dollars). Please remit your check, along with the executed license agreement to the following address. Upon receipt of your signed version of our license and payment of the administrative fee, we will return an officially executed agreement to you allowing the use of the MMSE.

MiniMental LLC
 31 St. James Avenue, Suite 1
 Boston, Massachusetts 02116
 Fax: (617) 587-4201

Please insure that the MMSE is appropriately cited in current and any future reproductions using the following boilerplate language:

- (1) "MINI-MENTAL STATE." A PRACTICAL METHOD FOR GRADING THE COGNITIVE STATE OF PATIENTS FOR THE CLINICIAN. *Journal of Psychiatric Research*, 12(3): 189-198, 1975 in any written materials.'
- (2) The copyright in the Mini Mental State Examination is wholly owned by the MiniMental LLC, a Massachusetts limited liability company. For information about how to obtain permission to use or reproduce the Mini Mental State Examination, please contact John Gonsalves Jr., Administrator of the MiniMental LLC, at 31 St. James Avenue, Suite 1, Boston, Massachusetts 02116 - (617) 587-4215 - in any written materials.
- (3) The copyright notice will be applied to all written materials in the following form: © 1975, 1998 MiniMental LLC.

In addition, we can also make available to you a laminated card to be used as a reference for the clinician. The Mini Mental State Exam card (a plastic card for easy lab coat insertion) includes a copy of the MMSE on one side, and a list of score norms by age and education level on the back. These cards can be ordered directly through our MiniMental office for a fee of \$10.00 USD per card.

Sincerely yours,

John Gonsalves, Jr., Administrator

Enclosures



Minimental LLC

Mailing Address: 31 St. James Avenue.
Boston, Massachusetts 02116
(617)587-4215 (617)587-4201 Fax
www.minimental.com

Invoice

Date: June 19, 2000

Bill to: Ms. Teresa Genge
Faculty of Nursing
University of Alberta
Fax: (780) 407-2006

From: John Gonsalves, Jr.
Administrator
Mini Mental LLC
31 St. James Avenue, Suite #1
Boston, MA 02116
Telephone: (617) 587-4200

Amount: \$85.00 Administrative fee for MMSE

Mini Mental LLC ID #04-3414548

Genge, Teresa

From: Theresa Drinka, Ph.D.[SMTP:drinkat@execpc.com]
Reply To: drinkat@execpc.com
Sent: Monday, June 19, 2000 11:28 AM
To: Genge, Teresa
Subject: Re: Use of the ALSAR for data analysis

Dear Teresa,
You have my permission to use the ALSAR in your study. Please let me know what your data shows. Also, I would urge you to consider publishing your study in a nursing or gerontological publication.

Best of luck,
Theresa Drinka, Ph.D.

"Genge, Teresa" wrote:

> Dear Dr. Drinka
> I am a Master of Nursing Student and I am analyzing data from an outpatient
> seniors clinic for my thesis. It is a retrospective project looking at the
> functional abilities of this senior group. The ALSAR is the tool used to
> assess IADLs in the clinic. I would ensure that all authors are
> appropriately referenced throughout my writings. I would like permission to
> use your tool in my project.
> Thank You very much for your supportive conversation.
> Teresa Genge

Genge, Teresa

From: surya.shah@tees.ac.uk[SMTP:surya.shah@tees.ac.uk]
Reply To: surya.shah@tees.ac.uk
Sent: Tuesday, June 06, 2000 10:20 PM
To: Genge, Teresa
Subject: Re: Use of the modified Barthel for data analysis

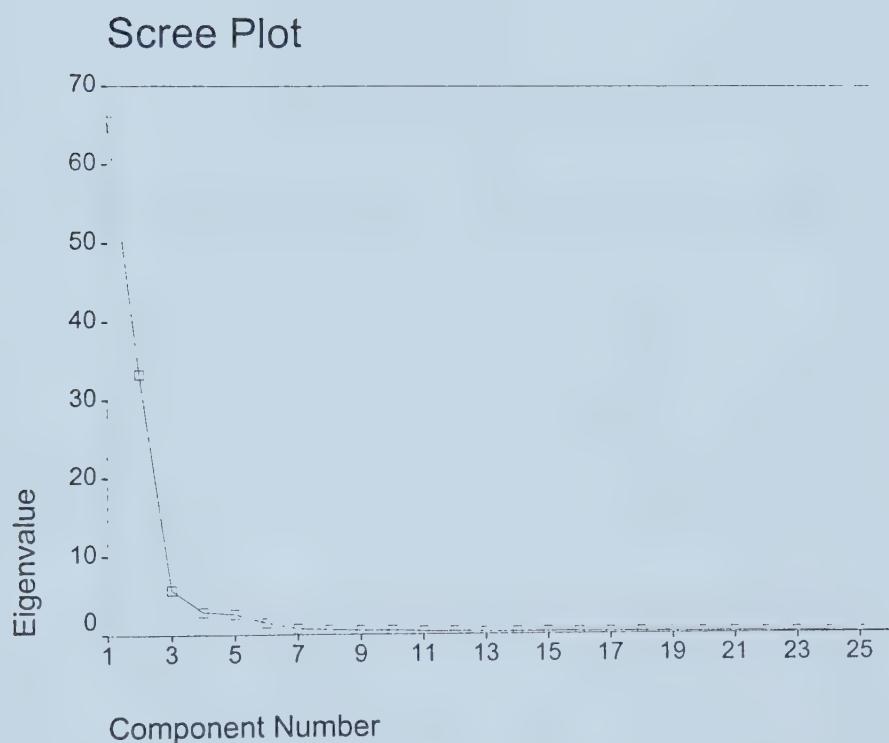
Thank you for your interest in the MBI. You are welcome to use the MBI . All you need to do is acknowledge the source in your thesis. I hope you have the current guidelines published in Compendium of Quality of Life By Sam Salek and published by Wiley and Sons or a CD-ROM by Tamburini from Milano Italy and Published by Glamm Interactive. If not, I can send you a hard copy by airmail. These are also on internet

Professor Surya SHAH
On Tue, 6 Jun 2000 13:43:41 -0600 "Genge, Teresa"
<TGenge@cha.ab.ca> wrote:

> Dear Mr. S. Shah:
> I am a Master of Nursing student and I am analyzing data in a seniors
> clinic for my Thesis project. It is a retrospective project looking at the
> multiple tools used in the assessment of the senior population that access
> the clinic. The Modified Barthel was used to assess the ADL skills. I would
> like to permission to use the Modified Barthel in my data analysis. Thank
> you for your attention on this matter.
> Yours truly Teresa Genge.

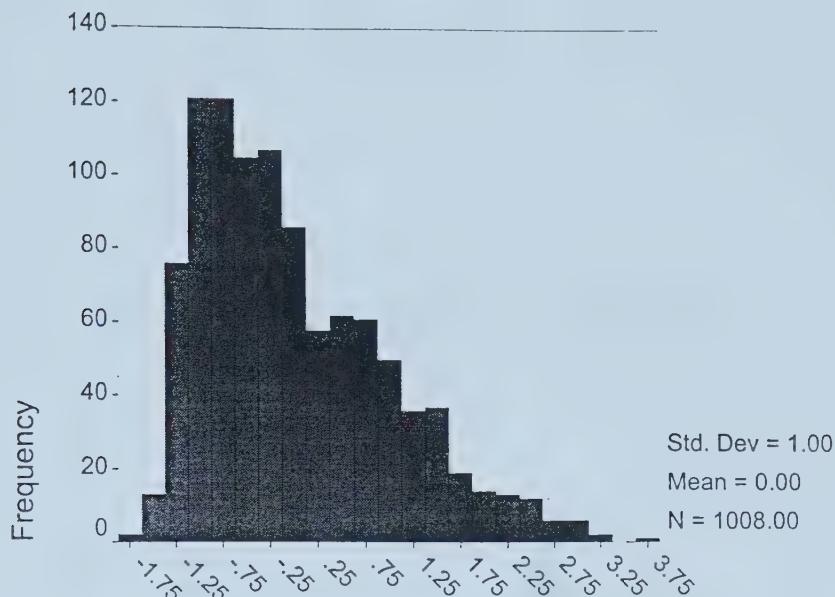
Surya Shah
@tees.ac.uk

APPENDIX E
SCREE PLOT FOR FACTOR ANALYSIS



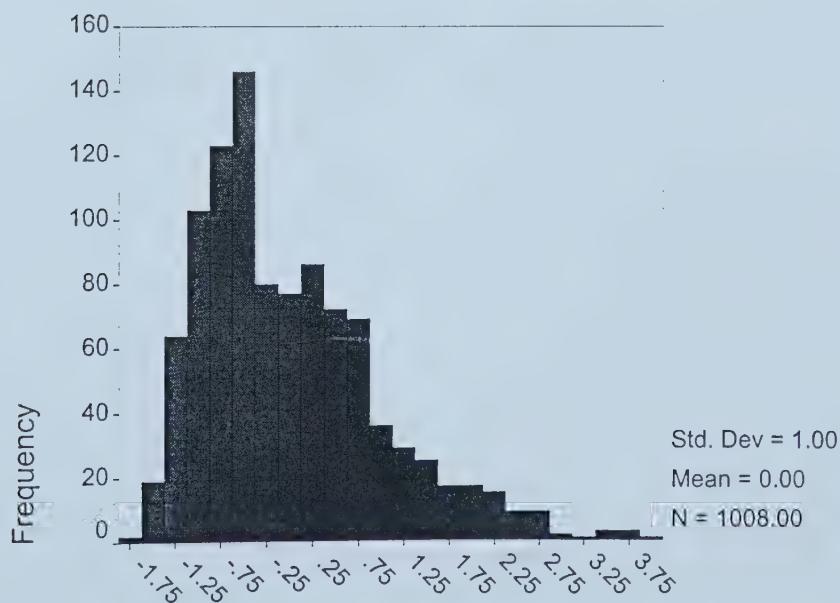
APPENDIX F
HISTOGRAMS OF THE THREE FACTOR SCORES

REGR factor score 1 for analysis 1



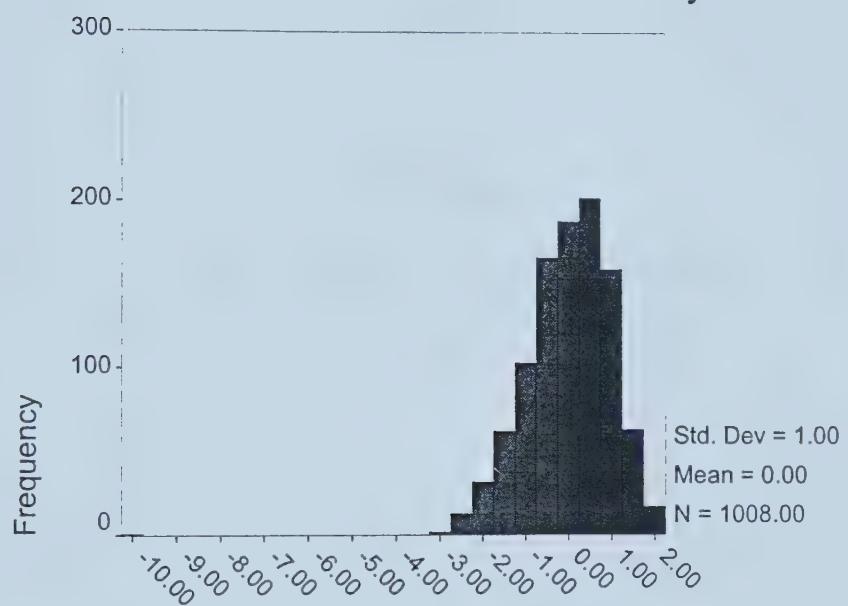
REGR factor score 1 for analysis 1

REGR factor score 2 for analysis 1



REGR factor score 2 for analysis 1

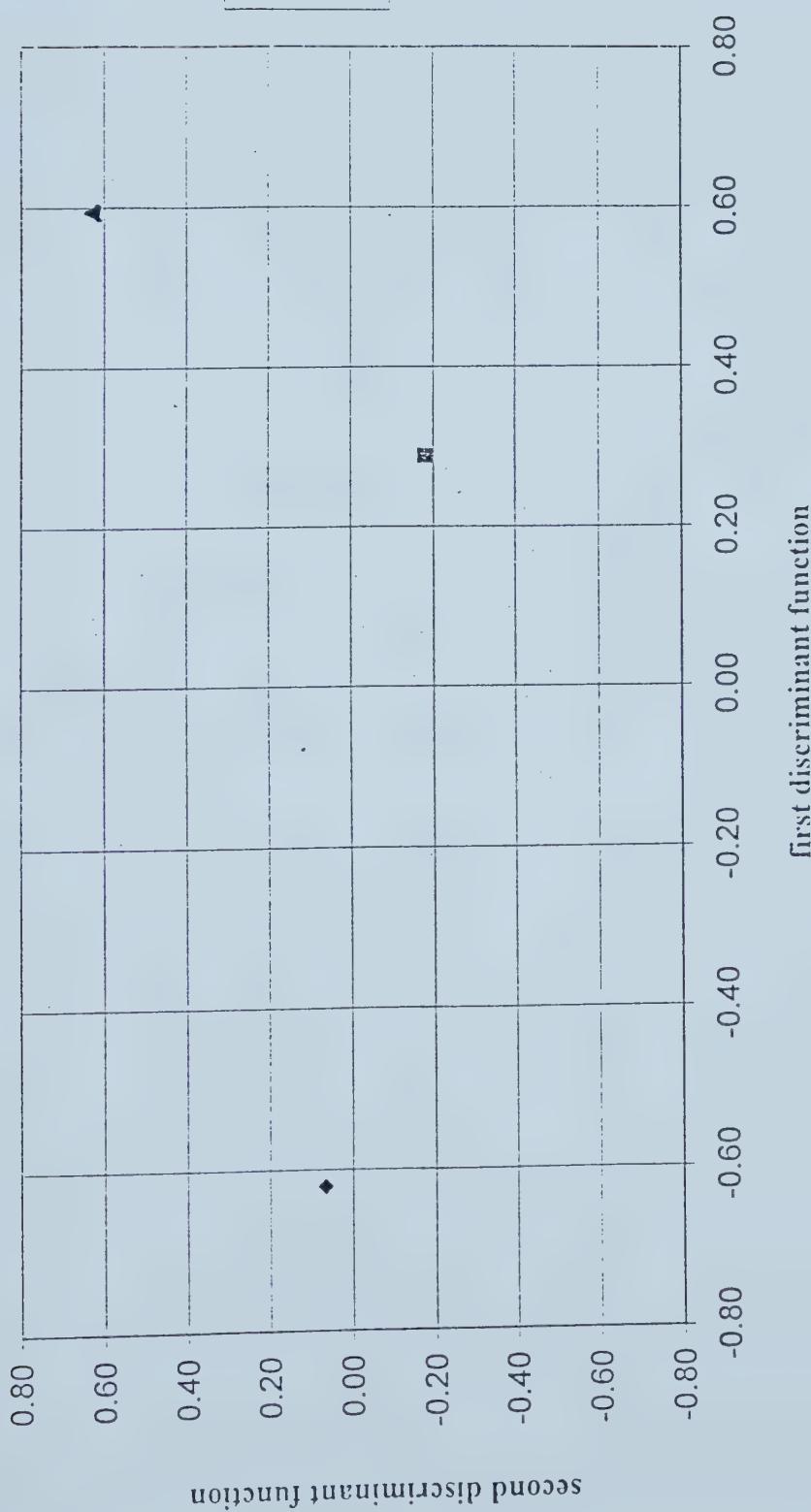
REGR factor score 3 for analysis 1



REGR factor score 3 for analysis 1

APPENDIX G
DISCRIMINANT FUNCTION PLOT

Discriminant Function Plot



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